

Popular Science

★ FOUNDED MONTHLY 1872

INVENTIONS
DISCOVERIES
RADIO
AUTOMOBILES
AVIATION
HOME WORKSHOP



SEPTEMBER

Giant plane designed to cross Atlantic in a day

25 CENTS

\$10,000 Prize Contest—See Page 31



Instantly, with a turn of the wrist, you retighten the head of any Plumb Tool. V-shape of wedge expands wood of handle against all edges of eye all the way in.

Look for the
Red Handle
with the
Black Head
(Color Combination
registered as
trade mark
in U.S. Patent Office)
EXCLUSIVELY
PLUMB



Black head on **red handle** means a better hammer

SEE what PLUMB has done to give particular tool-users a hammer they will appreciate.

A hammer, too, that will retain its good qualities through a lot of hard use.

With its larger face, for accuracy;
Its shorter neck, for better balance;
Its claws improved in pulling power;
Its head specially tempered—hard for service, tough for wear—

AND THE TAKE-UP WEDGE TO KEEP IT NEW.

The Plumb Take-Up Wedge retightens the black head of this hammer with a turn of the wrist. It keeps all Plumb heads tight on Plumb red handles.

The Take-Up Wedge preserves balance and hang and accuracy.

It keeps Plumb tools (exclusively) good as new!

FAYETTE R. PLUMB, Inc.
Philadelphia, U. S. A.

The PLUMB
Balanced Nail Hammer
At good hardware stores
\$1.30 (except in Far West
and Canada)



Startling! Revolutionary!

These new developments of Powel Crosley Jr.



Crosley owns and operates Super-Power Broadcasting Station WLW

A Genuine Armstrong Regenerative double circuit receiver

The CROSLLEY Pup \$9.75
WITHOUT ACCESSORIES

This compact, efficient receiver is an improvement of the famous Crosley one tube set, with which Leonard Wecker, of Minot, N. D., heard the MacMillan Polar expedition while the rest of America listened in vain.

The employment of the double circuit not only reduces radiation to a minimum, but radically improves selectivity. It can be tuned through local stations more readily. Under average conditions, its radius, with head phones, is 1500 miles or more.

You can use the "PUP" to check the performance of your larger set; to entertain that youngster whose curious fingers cannot resist the lure of dials and switches; to install in the maid's room, or even your office—for the air is full each day. You can take it on canoe trips, picnics, outings, and on your business journeys—for it's only half the size of a shoe box.

It is not offered as superior to the higher priced sets. There is a difference in volume of sound—but no difference in receptivity, selectivity, tonal qualities—or the enjoyment it offers.

The Crosley "Pup" is offered as a real selective, long distance receiving set. It requires one dry cell, one "B" battery block, one WD12 tube, a pair of head phones and antenna.

New CROSLLEY Super-TRIRDYNS for 1926

3 Tubes Do the Work of 5 or 6

You have not heard the perfection of radio reception until you have listened to these two new Super-Trirdyns. In them the need for more than three tubes is eliminated by the famous Trirdyn hook-up—which combines tuned radio frequency, Armstrong regeneration, and reflex amplification. There is no radiation. Distant stations come in clear and sharp on the loud speaker and can be accurately logged. Offered in solid mahogany cabinets of exquisite beauty and design, these new models are the aristocrats of radio reception at democratic prices.

The New Super-Trirdyn Regular

A beautiful cabinet job! Simple, yet rich. Oil rubbed solid mahogany. All metal dials give distinctive finishing touch. With new Trirdyn features incorporated it is a wonderful value at the price, without accessories - **\$50**



New Super-Trirdyn Special

The finest development of the famous Crosley Trirdyn—beautifully done. A magnificent cabinet of solid mahogany—simple in design. Richly finished with engraved metal dials. The case is large enough to contain all needed batteries if dry cell tubes are used. Price, without accessories - **\$60**



Add 10% to All Prices West of Rocky Mountains

It is expected that no less than 500,000 present day "good speakers" will be replaced by the Musicones in 1926, its first year. The Musicones reproduce the full vocal range of the human voice and music without distortion, over tones, reproduction of character. It requires no adjustments nor additional batteries. The patented acoustical unit is the secret of its faithful reproduction of all tones. Not the mere echo. Because of attraction to speakers. Covered by basic patents. Price **\$17.50**

The MUSICONES

An Improved Loud Speaker



Musicones De Luxe
The Musicones have been shown their complete work with a small unit of beautiful mahogany with a solid screen. Price **\$27.50**

TRIRDYN

Combination De Luxe

The new Super Trirdyn Special De Luxe Combination De Luxe, by Crosley and built by Crosley company, is a masterpiece of engineering and mahogany finish. The Super Trirdyn Special (combination unit) and the Musicones De Luxe, sold separately or combined. Price **\$112.50**

Radical Improvements in Other Popular Crosley 2 and 3 Tube Models!



New 2 Tube-51 Special Deluxe

These low priced models represent radical improvements in selectivity, performance, appearance, and value. More selective control and improved selectivity have been achieved by the use of the new wave type tickler, the new Crosley verter plate condenser and the double circuit. Price without accessories.

New 3 Tube-52 Special Deluxe

This model like the 41 contains the new Crosley improvement and represents also the 12.5 new wave type tickler, the new Crosley verter plate condenser, and the double circuit. Price without accessories. **\$32.50**



THE CROSLLEY RADIO CORPORATION

Crosley manufactures receiving sets which are licensed under Armstrong U. S. patents No. 1,111,165 and priced from \$9.75 to \$60 without accessories.

CINCINNATI

See the Crosley line at your dealer's

Write for descriptive catalog



A Personal Message to Men Who Want to Earn More than \$7,000 Every Year

By J. E. Greenblade

WHEN a civil service clerk earning only \$25 a week suddenly surprises his friends by increasing his earnings to nearly \$200 a week—when a farm hand earning only \$60 a month begins to earn \$1,000 a month—when a railway mail clerk earning \$1,600 a year changes his job and earns \$1,000 in thirty days—when hundreds of others quickly jump from small pay to magnificent earnings—then blame yourself if you do not do equally well.

There is nothing exceptional about these men. They'll tell you that themselves. Many had been clerks, bookkeepers, me-

chanics, farm hands—in fact, they came from all walks of life. And then in a very short period of time they found themselves making more money than they had ever dreamed possible. Today they know the thrill of money-making.

I Pledge You My Word You Can Do It

What these men have done, hundreds have done, hundreds are doing today, and hundreds will do tomorrow. And you can be one of them. The same opportunity is yours with no possibility of your failing to do equally as well if you follow my advice.

But first let me tell you why the same opportunity exists for you. In 12 months the National Salesmen's Training Association received requests for more than 43,000 salesmen from wholesalers, manufacturers, and jobbers—representative concerns all over the United States and Canada. Surely that is a tribute to the manner in which we train men for Master Salesmanship.

There are countless openings for men who really know how to sell—unlimited opportunities to make real money. And once you possess the secrets of Master Salesmanship you, too, can do equally as well as any of the men mentioned on this page.

A Foolish Notion About Salesmen

For some reason the average man imagines that, in order to make good in selling, he must be a "born" salesman. Nothing could be further from the truth. There is no such thing as a "born" salesman.

There are certain principles, certain rules, certain secrets to selling just as there are certain principles in mathematics and medicine. Once you know these principles you can quickly make good in the selling profession.

And through the National Demonstration Method—an exclusive feature of our System of Training—you gain the equivalent of actual experience in overcoming sales problems of all descriptions. Then, through the N. S. T. A. System of Electives, you get

the proved selling plans of Master Salesmen in the line or lines you want to sell.

Step by step this result-securing system of salesmanship training takes you through every phase of selling, and secrets of selling that have made millions of dollars are unfolded to you in a manner so simple and easy as to be immediately grasped.

Then there is the Free Employment Service at your disposal when you are qualified and ready.

Remarkable Book, "Modern Salesmanship" Sent—FREE

With my compliments I want to send you a most remarkable book, "Modern Salesmanship." It will show you how you can easily become a Master Salesman—a big money-maker—how the N. S. T. A. System of Salesmanship Training will give you the equivalent of years of selling experience in a few weeks; how our Free Employment Service will help you select and secure a good selling position when you are qualified and ready. And it will give you success stories of former routine workers who are now earning amazing salaries as salesmen. Mail the coupon today. It may be the turning point in your life.

NATIONAL SALESMEN'S TRAINING ASSOCIATION

Dept. M-15
N. S. T. A. Building
CHICAGO, ILL.



National Salesmen's Training Association
Dept. M-15, N. S. T. A. Building,
Chicago, Ill.

Send me FREE your book "Modern Salesmanship," and proof that I can become a Master Salesman.

Name.....

Address.....

City..... State.....

Age..... Occupation.....

Earns \$1,350 a Month

"Last month, I earned \$1,350 as a salesman. Have averaged \$1,000 a month the last year. I couldn't have done it without N. S. T. A. training."—A. H. Ward, Chicago.

\$1,000 in 30 Days

"After ten years in the railway mail service I decided to make a change. My earnings during the past thirty days were more than \$1,000."—W. Hartie, Chicago, Illinois.

First Month \$1,000

"The very first month I earned \$1,000. I was formerly a farmhand."—Charles Berry, Winterset, Iowa.

More Than \$10,000

"Your training has enabled me to learn more, earn more and be more. I am now president of a national organization, and my earnings for 1925 will easily exceed the five figure mark."—Charles V. Champion.

City Salesman

"I want to tell you that the N. S. T. A. helped me to a good selling position with the Stange-Walker Company."—Wm. W. Johnston, Jr., St. Minneapolis, Minn.

\$554.37 in One Week

"Last week my earnings amounted to \$554.37; this week will go over \$400."—F. Wynn, Portland, Ore.

\$100 a Week in Only 3 Months

H. D. Miller, of Chicago, made \$100 a month as stenographer in July. In September, 3 months later, he was making \$100 a week as a salesman.

\$10,000 a Year

O. H. Malfroet, of Boston, Mass., stepped into a \$10,000 position as a SALES MANAGER—so thorough is this training.



See How Easy it is to Quickly Become a Powerful Speaker

Powerful Speech has shown thousands an amazingly easy way to win advancement in salary and position, a remarkably quick way to gain popularity, standing and success. You, too, can quickly conquer stage fright, self-consciousness, timidity and bashfulness and become a powerful and convincing speaker who can bend others to your will and dominate one man or an audience of thousands.

THERE is no magic, no trick, no mystery about becoming a powerful and convincing public speaker. Those who believe that the ability to speak forcefully belongs only to a few lecturers are making a serious mistake. I will prove that you, too, can quickly become a powerful speaker and can use that gift to win promotion, salary increases, popularity, power. By an amazing five minute test I will show how to discover whether you are one of the 7 men out of every 9 who have this "hidden knack" and do not know it. Men in almost every profession and line of business have made this test and then taken their first step toward success in a large way.

What 15 Minutes a Day Will Show You

- How to talk before your club or lodge
- How to address bond meetings
- How to propose and respond to toasts
- How to make a political speech
- How to tell entertaining stories
- How to make after-dinner speeches
- How to converse interestingly
- How to write better letters
- How to sell more goods
- How to train your memory
- How to enlarge your vocabulary
- How to develop self-confidence
- How to acquire a winning personality
- How to strengthen your will-power and ambition
- How to become a clear, accurate thinker
- How to develop your power of concentration
- How to be the master of any situation

you keep hemmed in by self-consciousness, lack of confidence in yourself, timidity and bashfulness.

It Is Amazingly Easy to Quickly Become a Powerful Speaker

You do not need a college education nor any previous voice training to become a powerful speaker.

I will show you the secret that causes one man to rise from an obscure position to the head of a great corporation; another from the rank and file of political worker to national prominence; an ordinary trades union member to the national leadership of great labor unions; a timid and retiring man to change suddenly into a popular and much applauded after-dinner and banquet speaker. Thousands have accomplished just such amazing things due to this simple, easy, yet effective training.

others and what remarkable results have been secured often in a month's time. Therefore, if I can not make you a powerful speaker I guarantee to return every penny you have paid me and you owe nothing.

Amazing Book Free Mail Coupon

If you will fill in and mail the coupon at once, you will receive a remarkable new book called "How to Work Wonders with Words." This book gives you an amazing test by which you can determine for yourself in five minutes whether you are one of the seven men out of every nine who possess the "hidden knack" of powerful speech, but do not know it. Decide for yourself if you are going to allow 15 minutes a day to stand between you and success. Thousands have found this to be the biggest step forward in their lives. If it has played such an important part in the lives of many big men, may it not be yours? Then mail the coupon at once.



NORTH AMERICAN INSTITUTE

3601 Michigan Ave. Dept. 1366 Chicago, Ill.

Why Powerful Speakers Are Always Leaders

It is the man who can put his ideas into convincing speech—the man who can sway others at his will and dominate one man or a thousand—who is sought out and asked to fill big, important, high-salaried positions. He is a leader; he stands head and shoulders above the mass. I am going to prove that you can be such a man by simply bringing out your "hidden personality" which is fighting for recognition but which

You Become a Good Speaker—Or I Don't Want a Penny

I do not care what line of business you are in; how bashful, timid and self-conscious you now are; I will guarantee to make you a powerful, convincing and easy speaker within a few weeks if you will give me 15 minutes a day in the privacy of your own home. I know what I have done for thousands of

NORTH AMERICAN INSTITUTE
3601 Michigan Ave., Dept. 1366
Chicago, Ill.

Please send me your FREE Test and full information about your amazing new method of learning Public Speaking. This request places me under no obligation of any kind.

Name

Address

City State

Electrical Experts are in Big Demand!
—L.L. Cooke

I Will Train You at Home to fill a Big Pay Job!



Look What These Cooke Trained Men Are Earning



Makes \$700 in 24 Days in Radio

"Thanks to your interesting Course I made over \$700 in 24 days in Radio. Of course, this is a little above the average but I run from \$10 to \$40 clear profit every day, so you can see what your training has done for me."

FRED G. McINABB, 448 Spring St., Atlanta, Georgia



\$70 to \$80 a week for Jacquot

"Now I am specializing in Auto Electricity and battery work and make from \$70 to \$80 a week and am just getting started. I don't believe there is another school in the world like yours. Your lessons are a real joy to study."

ROBERT JACQUOT, 282 W. Columbia Ave., Colorado Springs, Colo.



\$20 a Day for Schrock

"Use my name as reference and depend on me as a booster. The biggest thing I ever did was answer your advertisement. I am averaging better than \$20 a month from my own business now. I used to make \$12.00 a week."

A. SCHROCK, Phoenix, Arizona



Plant Engineer—Pay raised 150%

"I was a dumbbell in electricity until I got in touch with you Mr. Cooke, but now I have charge of a big plant including 60 motors and direct a force of 34 men—electricians, helpers, etc. My salary has gone up more than 150%."

GEORGE J. L. WRIGHT, 61 Calumet Road, Holbrook, Mass.

It's a shame for you to earn \$15 or \$20 or \$30 a week, when in the same six days Electrical Experts make \$70 to \$200—and do it easier—not work half so hard. Why then remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a real job in the great electrical industry. I'll show you how.

Be an Electrical Expert They Earn \$3,500 to \$10,000 a Year

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the Electrical Expert—who is picked out to "boss" the ordinary Electricians—to boss the Big Jobs—the jobs that pay \$3,500 to \$10,000 a Year. Get in line for one of these "Big Jobs." Start by enrolling now for my easily learned, quickly grasped, right up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Drawback

You don't have to be a College Man; you don't have to be a High School Graduate. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My Course in Electricity is simple, thorough and complete and offers every man, regardless of age, education, or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from \$10 to \$50 a week.

No Extra Charge for Electrical Working Outfit

With me, you do practical work—at home. You start right in after your first few lessons to work at your profession in the regular way and make extra money in your spare time. For this you need tools, and I give them to you—big complete working outfit, with tools, measuring instruments, and a real electric motor—8 outfits in all.

Your Satisfaction Guaranteed

Be sure and that you can learn Electricity—no sure and that after studying with me, you can get into the "big money" class in electrical work, that I will guarantee you to be able to return every day to your job in full time, if when you have finished my Course, you are not satisfied it was the best investment you ever made. And best of all, in my guarantee, I include the Chicago Engineering Works, Inc., a two million dollar institution, that assuring to every student enrolled, not only a wonderful training in Electricity, but as a compensated student service as well.

Get Started Now—Mail Coupon

I want to send you my Electrical Book and Proof Lessons, both Free. These cost you nothing and you'll enjoy them. Make the start today for a bright future in Electricity. Send in Coupon NOW.

L. L. Cooke, Chief Engineer
Chicago Engineering Works
2150 Lawrence Ave.,
Dept. 38
Chicago

The Vital Facts



L. L. COOKE, The Man Who Makes "Big Pay" Men
Dept. 38
2150 Lawrence Ave., Chicago

Send me out now without obligation your big illustrated book and complete details of your Home Study Course in Electricity, including your outfit and employment service offers.

MAIL COUPON FOR MY FREE BOOK

Name.....

Address.....

Occupation.....

5 big outfits given to you—no extra charge

The Cooke Trained Man is the "Big Pay" Man



Be Superintendent of an
Electrical POWER PLANT



Own Your Own Electrical
REPAIR SHOP



Be an Electrical
Construction Jobs



Be an Electrical CONTRACTOR

Train At Home for a fine ELECTRICAL JOB and a big RAISE IN PAY!

If you are now earning less than \$40 a week

—If you want to be an ELECTRICAL EXPERT—if you want to step quickly into the class of men earning from \$60 to \$250 a week—write me at once! This million-dollar school offers ambitious fellows their big opportunity to learn every branch of Electricity at home in spare time by a wonderful, new, practical JOB-METHOD.

Learn Electricity quick by Dunlap "Job-Method"

My training so simple a school-boy can grasp it instantly. Common schooling all you need. No previous experience required. But my students make rapid progress because I train them on actual Electrical jobs with standard-size tools and materials which I supply without extra cost. The first half of my training is APPLIED ELECTRICITY—a complete course in itself. In the second half I give you Electrical Engineering subjects. I give you Electrical Drafting, Radio, Automobile Electricity, and many other valuable subjects all for one small price, and on easy terms.

Train for these Jobs!

Power Plant Superintendent \$5,000 to \$15,000 a year
Construction Foreman \$2,500 to \$10,000 a year
Chief Electrician \$3,000 to \$12,000 a year
Electrical Draftsman \$3,000 to \$10,000 a year
Automotive Electrical Expert \$3,500 to \$12,000 a year
Electrical Contractor Profits \$5,000 to \$50,000 a year

Earn Money while Learning

Dunlap-training combines money-making, practical experience and instruction IN A NEW WAY. I call this "JOB-METHOD" and it gives results—most quickly and easily than old fashioned ways of teaching. Early in your training I give you special instruction in house-wiring, Radio building, electrical repair work, etc. I show you how to get spare-time work—work you will be well paid for. Many students tell me they are making my training pay for itself in this way.

4 Big Electrical Outfits given

to you without one penny of extra charge. Not a "premium"—not something "FREE" to induce you to enroll. But costly, standard, full-size tools, materials, and equipment. The main-line motor of the same type as the big fellows in a power plant. Rans on Alternating or Direct Current, or 33-volt farm electric system. Come to you knock-down. It's part of your job to wind the armature and assemble it. That's the way you learn all subjects in Electricity by the Dunlap Job-Method.

Get my Pay-doubling Offer!

I GUARANTEE to train you at home for big pay position as ELECTRICAL EXPERT! Chief Engineer Dunlap.



THE AMERICAN SCHOOL is chartered by the state of Massachusetts since 1897 as an educational institution, not for profit. Over 200 educators, executives, and engineers have prepared the wonderful home-study courses we offer. The success of our graduates has made us one of the largest VOCATIONAL TRAINING institutions in the world. You will be astonished at the many ways we help our students and graduates progress to success.

I WANT TO BE AN ELECTRICAL EXPERT

Chief Engineer Dunlap
AMERICAN SCHOOL, Dept. E-475
Drexel Ave. & 58th St., Chicago

☐ I want to be an Electrical Expert. Please send me a catalog, job-service facts, complete information, money-saving offers.

Name

St. No.

City State

MAIL COUPON TO-DAY

Chief Engineer Dunlap, Electrical Division
AMERICAN SCHOOL
Dept. E-675
Drexel Ave. & 58th St. CHICAGO

10 Motor-4 Big
Outfits Given to
every Student
Not a Penny Extra Cost

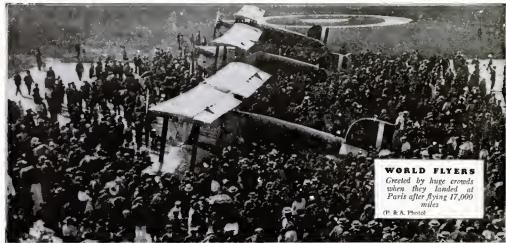
Chief Engineer DUNLAP

Training built by 23 Noted Engineers

This is an one-man, one-idea school. 22 noted engineers, educators, and executives of the following great corporations and universities have helped Chief Engineer Dunlap make this training complete and up-to-date. Ask any well known Electrical Engineer about the quality and standards of AMERICAN SCHOOL home-study in electricity.

- | | |
|---------------------------------------|---|
| 1. General Electric Co. | 8. Columbia University |
| 2. Commonwealth Edison Co. | 9. Dartmouth College |
| 3. Crocker-Wheeler Co. | 10. Massachusetts Institute of Technology |
| 4. Collins-Hammer Mfg. Co. | 11. Lehigh University |
| 5. American Telephone & Telegraph Co. | 12. University of Vermont |
| 6. Westinghouse Electric & Mfg. Co. | 13. Armour Institute of Technology |
| 7. Western Electric Co. | 14. University of Kansas |
| 8. Underwriters Laboratories, Inc. | |

AND MANY OTHERS



WORLD FLYERS

Greeted by huge crowds when they landed at Paris after flying 17,000 miles

(P. R. A. Photo)

Daring Young Men Needed in Aviation

Aviation in America is on the threshold of an amazing new development. The prediction of pioneers is now an actuality—for in the past few months the newspapers have announced the establishment of gigantic commercial air lines. The biggest capital and business forces in the world are behind this enterprise. And now, even in the beginning, thousands of young men are needed. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

THERE is no field of work in the world today which offers such amazing opportunities to young men of daring and who love adventure as does Aviation. Although still in its infancy, there is a crying demand in Aviation for young men with courage, nerve and self-reliance. For those who can qualify there will be thousands of highly paid jobs which will lead quickly and surely to advancement and success.

Big Opportunities Await the Trained Man

Look over the fields of work which are open to the young man today. You will find that Aviation is the ONE FIELD that is not overcrowded—the ONE FIELD in which there is plenty of room at the top. Think of it! Only 21 years ago Orville and Wilbur Wright made the world's first airplane flight. Now airplanes

fly around the world. Yes, Aviation offers the same wonderful opportunities today that the automobile and motion picture industries did 15 and

20 years ago. Men who got in on the ground floor of those industries made fortunes before others woke up. AVIATION IS NEW! It clamors for nervy young men—and the trained man has the world before him in Aviation.

Easy to Become an Aviation Expert—\$50 to \$100 a Week

You can qualify now quickly for one of these exciting highly paid jobs

through a new, sure, easy method of training. The study of Aviation is almost as interesting as the work itself. Every lesson is fascinating and packed full of interest. That's why Aviation is so easy to learn—you don't have to force yourself to study—once you start, you can't get enough of it. Only one hour of spare time a day will give you the basic training in an amazingly short time.

PREPARE For One of These POSITIONS

Aeronautical Instructor
\$60 to \$150 per week
Aeronautical Engineer
\$100 to \$200 per week
Aeronautical Constructor
Enormous Profits
Aeroplane Repairman
\$40 to \$75 per week
Aeroplane Mechanician
\$40 to \$60 per week
Aeroplane Inspector
\$50 to \$70 per week
Aeroplane Salesman
\$5000 per year and up
Aeroplane Assembler
\$40 to \$65 per week
Aeroplane Builder
\$75 to \$200 per week

One student, S. F. McNaughton, Chicago, says: "Your lessons are like a romance, and what is more, after one reading, the student gets a thorough understanding. One never tires of reading them." James Powers, Pa., another student says: "I am indeed surprised that such a valuable course can be had from such practical men for so little cost."

Personal Instruction By Experienced Men

Men who have had actual experience in Aviation give you personal attention and guide you carefully through your training. They select the lessons, lectures, blueprints and bulletins. They tell you the things that are essential to your success. Every lesson is easy to read and quickly understood.

Big Book on Aviation FREE

Send coupon below for New Free Book, just out. "Opportunities in the Airplane Industry." It is interesting and instructive and will show you many things you have never known before. Only a limited number offered—get yours before the edition is exhausted.



American School of Aviation
Dept. 1366

3601 Michigan Ave., Chicago, Ill.

AMERICAN SCHOOL OF AVIATION,
3601 Michigan Ave., Dept. 1366, Chicago, Ill.

Without any obligation, send me your Free Book, "Opportunities in the Airplane Industry," also information about your course in Practical Aerodynamics.

Name

Street

City State

NOW FREE!

The Book That Shows the Way
TO A **JOB** AND A **RAISE**
AND A **RICHER**

*Send for
it
Today*

BE AN
TITO

**Cooke
Student Jos.
Weronecki Made
\$100 in a Week!**

If you want Big Pay, a real job, or a Business of your own—if you're making a real lot (over \$10 a week)—**CLIP THAT COUPON RIGHT NOW!** [I send you my big book "AUTO FACTS" without a penny's charge.]

This Book Has Shown Hundreds of Men the Way to Success!

The book that I am offering to send you **ABSOLUTELY FREE** is the same book that started hundreds upon hundreds of men on the way to Amazing success. **Jefferson** and his successful Auto Experts. **Why Just Look at Joseph Wernick, Harold, Mrs. W. only making \$21 a second** was only **wrote for my book Today** writes me that he made **\$300 IN A SINGLE WEEK!**

Mr. Wozniak is just ONE of HUNDREDS who are making big money as Auto Experts. Just send the coupon and I'll give you FACTS—proven facts! I'll show you that YOU can have real success and BIG PAY as a Cooke-trained Auto Expert! If you are between the ages of 15 and 60 and can read and write plain English

Get into the World's Biggest Business—It Needs You!

Get all the facts on this wonderful
Auto Business—the Biggest Business in all
the World—it needs you! East, West,
North, South—everywhere! BIG JOBS pay-
ing all the way up to \$150 a week, and
big money for steady work. Thousands
of Money-Making Opportunities are waiting
for YOU! Think of it—FIVE THOUSAND
Million Dollars are poured into the pockets
of Auto Experts every year in this gigantic
business. You can be one of them. You are
the BIG PAY as a Cooks-paid Auto Sales.

HERE'S
PROOF! See What I
Can Do For
\$100. Hundreds! Sure Time
M. That's what Leo Crowl, 215 Wash-
St., Medford, Oregon, earned in
time before graduation. More than
times what his training cost. See how
unmake your spare time bring you
\$100. Raise in 100 months. Harry A.
Day, St. Fitchburg, Mass., made
his spare time while taking his
to pay up all his debts—and on
at. Dashed His Salary in 100
Months. These men give "Join-
ing full credit for their success."

LEARN **HOME** THE COOKE "JOB-WAY"

Keep your present job.
Get started on the way
Big Pay as an Auto Expert
through Cooke's "Job-Way"
easily, RIGHT IN YOUR
OWN HOME! Being a practical Director
Engineer, Owner and Head of this Institution
I know that practical money-making training
you need to be a BIG PAY MAN—and that
I give you! My free Book shows
you how successful I've been and how success

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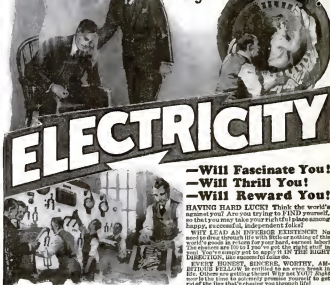
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"INVENTOR'S ADVISOR," the valuable Patent book with 139 mechanical movements and illustrations, sent free upon request. — M. S. Lahner, Patent Attorney, 3 Park Row, New York.

PATENT license as one of the oldest patent firms in America we give inventors at least equivalent charge, a service called for. — L. L. Lutz, evidenced by our many well-known Patents of extraordinary value. Book, PATENT—See page 10. — L. L. Lutz, 648 W. St., Washington, D. C. Established 1880.

MILLIONS spent annually for small business men (invented) Patent laws and profits. Write today for free book—tells how to protect yourself, how to invent, ideas wanted, how to help you sell, etc. — American Industries, Inc., 501 Monroe Bldg., Washington, D. C.

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HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and save money. — American Photography, 117 Camera House, Boston, 17, Massachusetts.

ESTABLISHED Journal of home, as a photographic expert, make \$75 a week while learning; professional camera furnished free; write quick for full information. — International Studies, Dept. 1743, 8361 Michigan Ave., Chicago.

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BESTER Printing for Low Money. Write us about your printing needs, and you will save money. — Green Printing Company, 625 South Dearborn Street, Chicago.

RICH Color Printing—500,000. — Hammett Bold Letter Books, \$13.75, 10,000, \$24.00. 6 1/2 white wove envelopes, \$2.00 per thousand. The Courier Company, Cincinnati, Ohio.

1,000 BOND Letterheads, envelopes, #625, 500, \$2.25, postpaid. — Memphis Free Press, 66 Providence, Worcester, Mass.

100 Business Cards, 80. — Four lines of type. — Wilderberg Press, Box 37, East Cleveland, Ohio.

PRINTING Omaha Press. — Typographic Stamp for information. — Nicholas P. 110, High St., Boston.

QUALITY Printing—2,000 Full Size Letter Heads, #125, 5,000, \$13.75, 10,000, \$24.00. 6 1/2 white wove envelopes, \$2.00 per thousand. The Courier Company, Cincinnati, Ohio.

DISTINCTIVE Printing! Ask for samples. — Franking Press, B-34, Milford, New Hampshire.

COMPLETE printing outfit, press, type, ink, paper, supplies. Write for Catalogue. — Press Company, New Milford, Conn.

HAILENBELL, 20 E. Willis Road, Indianapolis, \$4.75—1000. District Press, 1343 H St., Washington, D. C.

1,000 BOND Letter Heads (#625). Envelopes or Cards, \$1.50, 500, \$2.25. — G. C. Pipher, Hightstown, N. J.

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2,000 MILLER Duplicates with one tone. Any device equipped with our Simplified Instructions, including Easy Lay-out and Photo 25. — Verna Radio Co., Dept. ES-117, Oakland, Calif.

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"ACRUALINK," the perfect indoor aerial. Two under any desk telephone. Sample \$10.00 postpaid, complete. Radio Sales House, 1100 West Sprague, N. Y.

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WASH Clothes the new way. Use the Thru-Tant Automatic Washer. No hot water. No soap. No ironing. No drying. Put in each locality. — Sierra Royalty Co., 3614 Eighth St., Los Angeles.

"WANTED"—Representatives in every factory in the United States. Popular Science Monthly, 240 Fourth Ave., New York.

CASH to earn \$50 a week showing women showing new kind of night shoes. No experience needed to earn \$15 a day. Hundreds already doing it. Write quick for full particulars. — Stylized Shoe Company, Dept. 10, Cincinnati, Ohio.

STUCK With Your Own Products—Jerusalem Products. — Trade Agents. Catalog free. — C. Thaly Co., Washington, D. C.

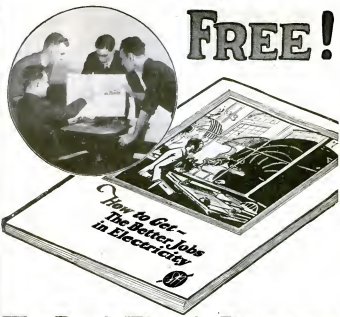
"The Dollars will buy the material for setting Machine in just 10 minutes. — Stylized Shoe Company, Dept. 10, Cincinnati, Ohio.

SALESMEN: Newly invented, fast selling, super-profit ball gum vendor. \$10 commission for one sale. Invention made in U.S.A. — Stylized Shoe Company, Dept. 10, Cincinnati, Ohio.

EMBROIDERED display signs mean big money, and independence for you. Sell every merchant making 25¢ profit. The proposition. — Stylized Shoe Company, Dept. 10, Cincinnati, Ohio.

WFO—Daily Drive. — Moseley Advertising Associates, 1100 West Sprague, N. Y.

More Money Making Opportunities on pages 10 to 17



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There is such a call for men now that we are giving an electrical outfit for experimental and practical home use if you enroll now. Think what it will mean to leave forever the low pay rut to become a trained, efficient electrical technician, capable of managing and supervising ten or five hundred men on the biggest jobs; to travel; to be a man of influence — to have a salary of \$3,000 to \$10,000 per year. Find out now how you can do this. You cannot afford to delay a day. Send right now for this wonderful free book that is pointing the way for thousands to big money in electricity. The coupon brings this book entirely free, without obligation. Fill it out.

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No other field today offers such great opportunities as Radio. Take your choice of the many wonderful openings everywhere. Prepare now to step into the most interesting and best paid profession today. Read about the opportunities open now—the different kinds of work—the salaries paid. Write today for the 32-page book that tells how America's biggest Radio correspondence school (government recognized) can teach you to become a Certified Radio-technician in your spare time and how Special Offer to those who act at once! Mail coupon or write letter now. National Radio Institute, Dept. 1118-B, Washington, D. C.

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Street.....

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Money Making Opportunities

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AGENTS—Make a dollar an hour, sell Menzies, a safety switch for instantly neutralizing lightning bolts, electric parkings, etc. Columbia Mfg. Co., Dept. 467, New York, N. Y.

EARN \$10 daily diverse returns, playing and recording metal wavy, beautiful, shattering, melodious, quills imitated, P. Deet Laboratories, 1133 Broadway, New York.

AGENTS—Write for free samples, Sell Madison "Secret" Double Shirts for men, fasteners, cannot be worn. No capital or experience required. Many earn \$200 weekly and more. Madison Mfg., 611 Broadway, New York.

WE start you without a dollar. Soap, candles, perfumes, toilet room. Experience unnecessary. Carmichael Co., Dept. 21, St. Louis.

SALESMEN—Four hours plus reduced to 20¢ per hour, your patients, no money, no experience, no capital, no risk for free outfit. \$5000—Field, 11100 Washington, Wash., D. C.

New Camera lens and lenses photo in one minute. Make money selling cameras or taking photos. Exclusive territory. Crown Co., Dept. 63, Newark, Conn.

AGENTS—Visit \$75 to \$100 a week. "Fruit" and Repair auto punctures and blowouts. Sample free. Montgomery, 2221 Washington, Chicago.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains many important facts which will be interesting and valuable to you. It also tells "How You Can Use the Popular Science Monthly Profitably." It will tell you how, without a dollar, you can get your inquiry to Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

BIG money and fast sales. Every owner buys gold medals for his auto. You charge \$1.00; get \$1.25. Write for free sample. American Monogram Co., Dept. 47, East Orange, N. J.

AGENTS, both sexes, we manufacture and control new household appliances. Fast seller. Big profits. Exclusive territory. Write for Circular. 123 Lafayette, New York.

AGENTS: Seasonal Summer Bells. Just out. \$100 a week possible. World Sales 160-W Washington, Chicago.

AGENTS: \$11.00 daily in advance (used for seven profit) introducing New Insulated House of 17 stories, 40 stories, 60 stories, 70 stories, 80 stories. Five days ready. No capital or experience required. You simply take orders, collect and collect for your own profit. Credit given. FAY YOU DAILY, monthly, bonus bonus. We furnish samples. Square time will do. Madison Mfg. Co., Dept. 467, New York, N. Y.

AGENTS—\$45.00 to \$100.00 per week, selling car radios, selling Motor to most people, sell from building trade, every user of radio needs one of these radios. Fast seller. Sample mailed. \$1.00. Write for particulars. Louis O. H. Co., Dept. 467, New York, N. Y.

AGENTS—\$55 to \$100 a week. High grade all wood made, no materials, \$25 and \$50. Write for sample. Money back guarantee. Free sample outfit. Write for Circular. 123 Lafayette, New York.

\$100 WEEKLY—pleasant work; opportunity local agents to introduce Modern Household Foods; no canvassing; no door-to-door; no money invested. Admit Industries, 445 Congress, Chicago.

AGENTS Wanted—Selling now—Fry-Joyce sells easily. Make a spectacular dent in your home, houses, factories, stores, practically buy on sight. Our Fry-Joyce is \$100 a day. Exclusive territory for producers. If you wish to establish a business of your own with fast and profitable for making big money, write today. Fry-Joyce Co., 117 Fry-Joyce Bldg., Dayton, O.

AGENTS: It's the season's greatest selling hit. Every man, woman and child will want this. Write for Circular. 123 Lafayette, New York. Free sample. Also Free Home Business, Profit Business, Social Business, Dues Book, National 250 Fourth Avenue, New York, N. Y.

WORLD'S Largest Neckwear Manufacturer wants salesmen. Opportunity \$20,000.00 profit. Commensurate with experience. Cincinnati values. Write for Circular 1000 Beaconview Bldg., Boston, Mass.

EARN \$41 to \$45 extra week, selling beautiful shirts. Customers in advance. We deliver and collect. Write quick. Fashion Wear shirts, Dept. L-361, Cincinnati, Ohio.

SALESMEN: If you think in terms of \$4000 the first year, write me. Without fee for retail orders. Nationally advertised. Established concerns with advertising budgets looking for advance to producer. Geo. R. Williams, 1021 Euclid Avenue, Cleveland, Ohio. Dept. P. S.

WE pay \$45 a week, furnish goods and expense to introduce our Soap and Washing Powder. Bismarck Company, Dept. 445, Chicago, Pa.

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\$100 PROFIT—With \$150 Outfit. Big Money—Write for Circular. 123 Lafayette, New York. Free sample. Also Free Home Business, Profit Business, Social Business, Dues Book, National 250 Fourth Avenue, New York, N. Y.

WE start you with no money, no experience, no capital, no risk for free outfit. \$5000—Field, 11100 Washington, Wash., D. C.

SALESMEN—Earn \$50 to \$75 per week selling LYNX Gilt Combs, every place a prospect. Write today for information. E. D. Christie, Peabody, N. Y.

FOR absolutely largest advertising deal. Exclusive territory, with worth \$150.00 per week, is available to right man. Particulars free. Mark Sales Company, 217 Broadway, New York, N. Y.

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More Money Making Opportunities
on pages 10 to 17



These designed for the...
I have a Super...
I make more than \$300 a month...
I trained them to make \$350.00 a year

I HAVE hundreds of letters like these which tell the gripping, stirring story of men rescued from ordinary, act-no-where lives into a new life of success, freedom, steady income, and the door of opportunity wide open before them.

And I did it! Men without training, without experience or preparation—men who did not know a T-square from a triangle—I trained them into practical draftsmen, sure of themselves, certain of steady employment and a good salary.

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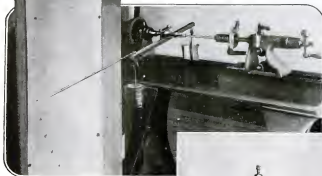
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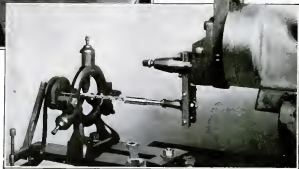
Music  **Master**
RADIO PRODUCTS

Putting a Screwdriver through the Mill

By DAVID B. PORTER, Ph.B.
Popular Science Institute of Standards



Here a screwdriver is undergoing the "torsion test," which determines the degree of toughness of the blade. A weighted arm is clamped to the screwdriver handle. Angular deflection on the chart indicates blade resistance



The wearing qualities of the spiral mechanism of this ratchet screwdriver here are subjected to a test in a few hours that equals many years' ordinary usage

THE screwdriver is perhaps our simplest tool—so simple, in fact, that its misuse is mastered readily and we sometimes wonder if it is not misused more than used.

When some ice is wanted, and the pick has rolled under the icebox, the feminine members of the family invariably seize upon the screwdriver and hammer. Or, when that new piece of furniture arrives firmly crated with stout nails, the screwdriver again is resorted to with the hammer following it up. This time it is not only used as a crowbar, but tried out as a cold-chisel when some misdirected blows drive the edge half through a nail.

In devising tests for screwdrivers, it is obvious that the Popular Science Institute of Standards can consider only the legitimate uses for which they are designed. But, as our tests have proved, there are any quantity of screwdrivers on the market that will not stand up under even normal usage. Such screwdrivers (as well as other tool and radio products that do not pass the Institute's tests) cannot be advertised in *POPULAR SCIENCE MONTHLY*.

THE chief requirements for screwdrivers are that the blades be sufficiently hard to resist wear and prevent rounding corners, and tough enough to turn the screw without being twisted. There is a limit, however, to the degree of hardness, because brittleness also increases with the hardness and a blade that is too brittle soon breaks at the corners.

The degree of hardness is measured by the scleroscope—an instrument that has had very wide commercial use in testing the hardness of steels. From the results of such tests, it is possible for the engineers of the Institute to tell whether the blades have the right degree of hardness.

The toughness of the blades, or their

ability to resist twisting, is determined by our "Torque Test," which is illustrated at the left of the page. An arm is clamped to the screwdriver handle and successive weights are applied. For each weight the angle of twist is read on the scale behind the pointer, and from this the load in pounds-inches is determined. The angular deflection on the chart tells instantly how the steel of the blade is acting as the

load increases. The torsion applied in this test exceeds that which could be exerted by the strongest mechanic.

In the case of the spiral ratchet screwdriver it is necessary to go further than a test of the blade, and to determine the wearing qualities of the spiral mechanism. By use of ingenious tests devised by the engineers of the Popular Science Institute of Standards, it is possible to give this mechanism many years' wear in a single afternoon.

THE illustration on the right shows how this is done. The tests are carried out on a shaper, the traveling head of which gives the reciprocating motion needed to produce the kind of wear that would develop any defects in the mechanism of the tool. Exact measurements are made of the amount of wear occurring in the spiral mechanism. The pressure against which the reciprocating head works has been predetermined by establishing the pressure exerted by a mechanic in driving a screw into an oak block.

In addition to the above tests, the screwdrivers are inspected for finish and workmanship, the handles for security, and ratchets and locks are carefully tested to see that they function easily after the screwdrivers have been subjected to further severe torque and wearing tests.

Send for List of Approved Products

POPULAR SCIENCE
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The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

Popular Science Monthly guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in Popular Science Monthly may expect that these products will give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by Popular Science Monthly.

THE PUBLISHERS.



Another exclusive Grebe feature: One dial can operate all three—or they can be set separately at will.

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The Synchrophase now has One, Two or Three-dial Control

THE three condensers operate from one dial—or separately at will. This first real, flexible form of "unit-control" marks another milestone on the road of Grebe leadership.

The new Synchrophase has the same *Binocular Coils* which give that unusual "selective sensitivity" so universally prized; the same Straight-Line-Frequency Condensers that make accurate tuning easy.

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All Grebe apparatus is covered by patents granted and pending.



Cracks in the Earth Menace Big American Cities

Scientists See the Need for More Widespread Knowledge of Earthquakes and Their Causes

By Arthur Selwyn Brown, Ph.D., LL.D.

ABOUT the last thought, probably, that occurs to the average American is that he may be living in an area of earthquake danger. It is only following disasters such as the recent ones in Santa Barbara, Calif., and Montana that people in this country realize that earthquakes are phenomena not confined exclusively to the more remote regions of the earth.

As a matter of fact, earthquakes occur in the United States every year—many of them. More than that, they occur in places that point to the existence of definite lines of earth weakness passing through or near some of our greatest cities. New York, Washington, and Boston, for example, lie along one of these lines, and consequently are not entirely removed from the danger of earthquake.

Other similar lines are found stretching across the continent from southern California to the Atlantic Coast, sweeping up through the Mississippi Valley to the Great Lakes, and cleaving the center of New England. Within these areas live millions of people.

To alarm them is not my intention. What I wish to do is to call attention to the pressing need of an intensive seismological survey of the United States and Canada—a work that too long has been neglected because its importance has not been foreseen.

There is need, too, for our architects, engineers, and builders to develop proper foundations and earthquake-proof houses for regions where earthquake dangers exist. It is the ground, not houses,

that moves, and resilient houses would usually not be injured by an earth tremor. A severe shock in any of the cities that lie along the faults or lines of earth weakness in this country would have most calamitous results with buildings of the existing type.

A few far-sighted men have recognized this danger. Thus, almost immediately following the Santa Barbara earthquake, the owners of one of New York's most famous skyscrapers obtained a large insurance policy against possible damage to the building from earthquake.

Seismologists have, during the past 10 years, given attention to the world's principal volcanic zones. They have mapped the areas where the most numerous and pronounced earthquakes are recorded. These show that there is a

line of weakness encompassing the earth, starting in the Aleutian Islands and running through Alaska to California, Mexico, South America, the south polar continent, New Zealand, Tasmania, the east coast of Australia, Japan, and thence northward to the Aleutians again.

THERE is another belt around the Mediterranean, running to Persia and thence northward to Nova Zembla and the North Pole. The Mediterranean is linked with the Pacific by a zone traversing the northern portions of South America and running under the Atlantic to Morocco. Another line parallels this to the north. It runs through the Caribbean Sea, across the Atlantic to Great Britain and then along the Norwegian coast until it connects with the Asiatic Line

passing Nova Zembla.

A study of the annual reports of earthquakes in the United States plainly shows that there is also another important line of weakness starting in the southern parts of California, traversing Arizona, following the thirty-fifth degree of latitude, sending a spur up the Mississippi and Ohio rivers, then running eastward to the sea, and thence following the coastal ranges up to Prince Edward Island and Newfoundland.

Another line of weakness in North America may be found in Canada. The Great Lakes and the St. Lawrence were formed along fault planes that are still lines of volcanic weakness. The activity of the Saguenay fault in the St. Lawrence River is well known. It is



Santa Barbara's Ruins

State Street, the main street of Santa Barbara, Calif., a few hours after the recent terrific quakes hurled masses of masonry and debris from shattered business buildings into the middle of the wide streets, leaving behind a scene of destruction

not so well known, however, that a similar line of faulting is shown by the great rivers, lakes, and waterways stretching through Canada from the Atlantic to the polar seas near the Alaskan boundary. Whenever there is earthquake activity in California or in our southern and eastern states, we may be sure to find similar activity in Alberta, Saskatchewan, and Manitoba.

The influence of earth faults in developing rivers and lakes has been shown lately by seismologists who have studied the volcanic history of the eastern coast of Africa. Rift valleys containing lakes, swamps, rivers, and other water bodies run from Cape Town, through Nyanza, Taranki, Rudolph, and other lakes, to Abyssinia, where a large rift valley, triangular in shape, exists between Abyssinia and Somaliland. The Nile runs almost parallel to this East African earthquake zone, and that river apparently courses along a series of faults.

NEW YORK affords a clear case of river development by faulting. The Harlem River, which joins the Hudson and East rivers, flows through fault gorges in gneiss and limestone rocks. The dropping of large areas of rocks, just as those that followed the earthquakes in San Francisco and Santa Barbara, undoubtedly preceded the first flowing of the Harlem River. Here is one established fact showing the structural weakness of the earth in New York. The valley of the Hudson appears to follow lines of faulting also. These faults are connected closely with the rising of hills and mountains in the same or distant localities.

The earthquakes in California are along lines of faulting. They parallel the sea and the coastal mountains. In the sea are deep depressions called on the charts "deeps," which are points of earthquake activities. The majority of severe quakes in recent years have occurred along lines of weakness near one or more of these deeps. There are many such deeps in the Atlantic, off the eastern states of America, and in the Pacific, off our western coast. There is one off the Antilles; others are off Charleston, Cape Lookout, the Great Bank of Newfoundland, and the Azores, Canaries, and the Cameroons in the Atlantic. Still others are off San Francisco, Alaska, and Mexico, in the Pacific, besides many more off the coast of South America, in the South Seas, and around Australasia.

SIMILAR points that play prominent parts in disturbances in India and the Himalayas occur in the Indian Ocean, off Java, and in the Malay Archipelago. When the mountains rise, these deeps sink, indicating that earthquakes are not merely local phenomena, but are evidences of forces exerted upon the whole unstable crust of the earth.

What these forces are has not been determined. The best evidence indicates that earthquakes are caused by electrical disturbances originating far

down in the earth's interior. These disturbances recur in violent outbursts about every 10 or 12 years and always are accompanied by marked changes in climate.

The present summer of 1925, during which the Santa Barbara earthquakes and the shocks in the eastern states and elsewhere occurred, has been remarkable for its humidity, high barometric pressures, and frequent thunderstorms and electric

The earth carries a great weight of air. Any increase in this weight must make a considerable difference in the strains acting upon the thin crust of the earth. All who have worked in deep mines know that when there is a high barometrical pressure, the column of air in a deep shaft greatly increases in weight, and work in deep mines becomes increasingly arduous. When unusual climatic conditions occur in any given locality, there must be enough added pressure on the earth strains to cause the rupture of many weak zones that must cause a sinking, sliding, faulting, or folding of the rocks.

ELECTRICAL and magnetic forces operate in a similar manner. The earth is a large magnet surrounded by innumerable and powerful lines of magnetic force. These lines of magnetic force are surrounded by electric lines of force beginning at the south magnetic pole and winding spirally to the north magnetic pole. The rocks and molten material of the earth's interior are charged with magnetism and the earth's rotation serves to generate vast electric and magnetic currents.

Here we have a great natural dynamo constantly creating enormous electric and magnetic currents that are sent off into space to create new stars, suns, and planets.

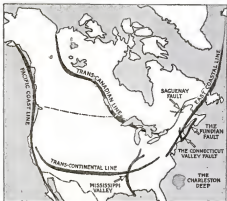
And we may view the sun, planets, and stars as acting in the same way. The sun alone

sends down to the earth enough electric and magnetic energy to cause enormous disturbances in the earth's magnetic and electrical fields and to profoundly change the position of the earth's axis and intensify the strains on the earth's crust. It is electric and magnetic waves of this character, coming from the sun and other stellar bodies, or, perhaps in some cases, from electrical ruptures in the clouds, that cause the principal earthquake and volcanic activities on the earth's surface. To be able to predict earthquakes, we should have world-encircling climatic and electrical observation stations to secure data to use in conjunction with seismological and astronomical data. The study of seismological data alone will never enable us to anticipate new volcanic activities.

KNOWING that earthquakes occur in their greatest intensities along lines of earth weakness, we should study the lines of weakness in the United States so as to be able to anticipate those parts that are most likely to be visited. To simplify this work, we might sketch a map to show the principal lines of faulting and the locality where earthquake shocks are of frequent occurrence in North America.

The whole western coast, between Alaska and Mexico, is well known to be on one of the greatest lines of weakness. The Pacific bed is falling, the coastal ranges are increasing in height, and the seacoast is hearing the greatest of the compression strains. The oceans grad-

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Earthquake Belts in the United States

This map of the United States, based on earthquakes that have occurred in the past, shows the principal lines of earth weakness. Some of these pass through or near some of our greatest cities. New York, Washington, and Boston, for example, lie along one of these lines that follow the Atlantic coastal ranges to Canada.

cal displays, all over the United States.

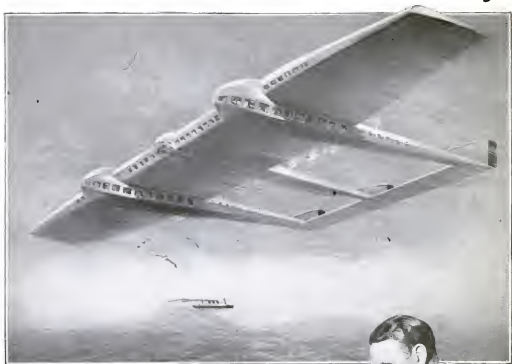
There is such a close correspondence between the periods of earthquake activity and the appearance of spots and prominences on the sun that some observers have assumed that earthquakes are caused by sun-spots. The truth, however, is that the sun-spots and volcanic activities on earth are merely evidences of the same universal forces of nature in operation.



Where the Earth Cracked

The recent severe earthquakes in central Montana opened up great fissures near the town of Great Forks, where the property damage was estimated at \$500,000. The crevice shown here is 100 feet long, in some places from two to five feet wide and from two to eight feet deep

New York to Paris in a Day!



Famous Designer Plans a Gigantic Air-Liner to Carry 75 Passengers

By Truman Stevens

WITHIN the next five years we shall see giant transatlantic airplanes that will carry at least 75 passengers from New York to Paris in 24 hours, and at a cost less than present passage on large steamships!

This prophecy comes, not from an idle dreamer, but from a hard-headed, practical designer of airplanes, a pioneer in aviation. He is Louis Breguet, French airplane manufacturer, whose factory in Paris is said to turn out more machines on a commercial basis than any other plant in the world.

The working plans for such an air monster already have been completed, according to reports from Paris, but M. Breguet expects that the machine will not be built, tested, and ready for trial flight before five years.

On this page and on the cover of this issue our artist has pictured how the great passenger plane, as described by M. Breguet, may appear in flight over the sea. The machine will be of all-metal construction, with twin bodies, capable of alighting on either land or water. With a load of 75 passengers, freight, and baggage, it will weigh 55 tons. Power will be supplied by eight motors develop-

Louis Breguet, French airplane manufacturer, studying plans for the giant passenger plane with which he expects to establish 26-hour transatlantic service between New York and Paris. Above is our artist's conception of how the great air-liner may look.



ing a total of about 5000 horsepower.

Luxurious passenger quarters in the two hulls and in the wings will include eight first-class cabins, 52 second-class, and 15 third-class. The first-class cabins will be six feet high, six feet wide, and 10 feet long. In addition, there will be a restaurant with electrical cooking equipment throughout, and a reading room and lounge where smoking will be permitted.

The crew of the giant seacraft will include, besides the commander, a chief electrician and assistant, two pilots, eight mechanics, four cooks, and a wireless operator.

It has been estimated that the cost of building the plane—about \$2,000,000—will be covered by receipts from 2000

hours' flying time. The passenger fare for each trip, it is predicted, will average about \$200.

According to present plans, the transatlantic flight in summer will be charted on a non-stop course between New York and Paris by way of Newfoundland, while in the winter a southern route will be taken by way of the Azores.

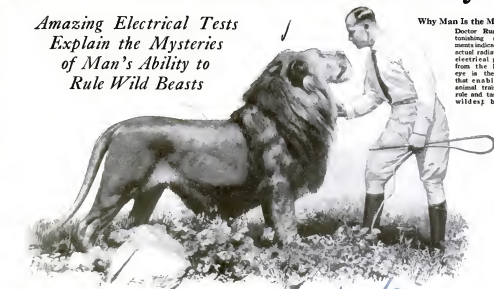
As you look at the artist's fascinating picture you can imagine yourself boarding the big ship at a New York flying-field, some morning in the near future, soaring out over the sea, plunging through the sky at terrific speed for a day and a night above the vast expanse of ocean, and finally arriving in Paris bright and early on the following morning.

The Power that Lies in Your Eyes

*Amazing Electrical Tests
Explain the Mysteries
of Man's Ability to
Rule Wild Beasts*

Why Man Is the Master

Doctor Russ' astonishing experiments indicate that actual radiation of electrical power from the human eye is the force that enables the animal trainer to rule and tame the wildest beasts



By Arthur Grahame

THE man cracks a whip and gazes commandingly at the tiger. The tiger glares its hatred for a moment, then looks away. Most dangerous of all the jungle clan, it could tear its tormentor to shreds with a few swift strokes of its mighty claw-armed paws. Instead, it cowers, trembling and, unwilling but submissive, goes through detested tricks.

This man who, armed with no weapon more deadly than a light whip, dares to match his will against the strength and ferocity of the most dangerous of animals, is no professional tamer of wild beasts. He is Charles W. Beall, senior vice president of an old and conservative Wall Street banking house.

Many of the big men of New York's financial district have their hobbies. Some sail racing-yachts on Long Island Sound. Some play polo at Meadowbrook. Others collect paintings. Mr. Beall trains wild animals. Instead of a polo stable he maintains a menagerie.

Standing with him in the building at Woodhaven, L. I., where he keeps his animals—at present the collection includes two tigers, three lions, three elephants, six leopards, one jaguar, and two monkeys—I asked him what gave him his unusual power over the lords of the jungle.

"Oh, just 'animal sense,' I guess," he replied. "A combination of a love of animals and an understanding of them."

A GOOD answer from the practical animal-trainer's viewpoint, but science has one even more convincing. From a London laboratory comes news that Dr. Charles Russ, an English physician formerly connected with the electricity-department of the Male Lock Hospital in London, has proved that the gaze of the human eye contains energy in some form—probably electro-magnetic energy

—powerful enough to swing a suspended wire coil through an angle of 60 degrees! Such proof of radiation of power from the human eye—its intensity varying with individuals—would seem to explain the mysterious ability of some men and women to subdue and dominate the strongest and most vicious of animals.

A few moments' talk with Mr. Beall convinced me that he was a man of exceptional personal magnetism, and that it had been his unrealized possession of this very power of the human eye that had first turned his thoughts toward his avocation of animal training.

"Other boys collected stamps," said Mr. Beall; "I collected animals. I can hardly remember the time when I didn't have animals. I grew up with them."

"Where?" I asked, with visions of a

boyhood spent at some African trading-post.

"Right here in New York City," replied Mr. Beall, smiling. "We lived in a big house, and I kept my menagerie in the cellar. I started with a bowl of goldfish. After that I had dogs and rabbits and squirrels. But such pets didn't satisfy me for long. I wanted something more unusual."

"FOR a long time I had followed the doings of the great animal trainers of that period with the same interest that boys of to-day follow the pitching of Walter Johnson and the home-running of Babe Ruth. I got to know some of these 'animal men'—fellows who made their living by capturing, training, and dealing in rare and dangerous beasts. Through one of these men I made my first real wild-animal acquisition—a pair of bear cubs."

"A little later I got a young leopard. A puma cub and an alligator followed. Before I was out of my teens I had added hyenas, panthers, and more leopards. By this time the cellar menagerie had become impossible. I had to move my animal collection to a farm in New Jersey, where I kept it for many years."

SO PERFECTLY trained are Beall's animals that he puts them to work for a part of each year. They have delighted thousands of visitors to New York's great playground, Coney Island, have performed in the New York Hippodrome, and have been rented to motion-picture production companies.

"And all those years, while you were working up from squirrels and bear cubs to elephants and tigers, you were learning how to control animals?"

"Learning" is not exactly the right word," replied the banker-trainer. "De-



Doctor Russ' experimental apparatus—a wire coil suspended by a thread inside a metal case and held steady by a magnet. The fixed gaze of human eyes, it was found, caused the coil to move from its former position

veloping' would be more accurate. You see, it is largely a matter of instinct. The real secret of animal training is bluff. If you can keep up your bluff, you are safe even in the cage with a tiger, the most treacherous and dangerous of all wild beasts. I never 'learned' to train animals; I developed a natural ability."

JUST what is this mysterious natural ability? The experiments conducted by Doctor Russ during the last eight years supply an answer—the electric power of the human eye.

Doctor Russ claims to have proved that the ordinary man can move a suspended inanimate object by looking at it steadily. Developed to high intensity, it is probable that this electric eye power is what enables men like Mr. Beall to quell the natural ferocity of dangerous beasts.

Most of us, at one time or another, have experienced the sensation of being stared at, and have turned to discover the identity of the persistent gazer. This common experience convinced Doctor Russ that there must be a real force emanating from the human eye. His belief was strengthened by the well-known fact that two persons cannot look into one another's eyes for more than a few moments without mutual and acute discomfort.

The evidence of modern science supports the belief that the human body is actually an electric power plant. All the muscles show electrical currents and variations of potential during action. There is an electrical change with each heartbeat. The retina of the eye has been shown to exhibit minute electrical activity during vision. Whatever the force coming from the eye might be, Doctor Russ decided, a part of it probably would radiate in the form of electricity.

Unlike Mr. Beall, Doctor Russ did not attempt to demonstrate this power by making a tiger leap through a hoop. Instead, he constructed the simple piece of apparatus shown in the illustration on the opposite page.

TO DEMONSTRATE his theory, it was necessary that an object should move when the human gaze was directed on it, and to do this the object had to be placed under such conditions that nothing but eye power could account for the movement. Doctor Russ made a wire coil and suspended it by an unspan silk thread in-

Tigers Obey His Will

Charles W. Beall, New York financier, whose hobby for years has been the training of wild animals, and whose remarkable power over tigers, lions, elephants, and jaguars is explained by electrical radiation of the eye



side a metal case. One end of the thread was fastened to a cork at the top of the "chimney"; at the other end hung the coil. Just above the coil he fastened a small magnet, which, taking a north-south position, held the coil steady. The coil itself was so adjusted that it was in an east-west position. A small window in the metal case allowed the gaze to be directed at the coil, and made possible the observation of any movement. A scale was arranged below the coil for accurate measurement of the movement.

Electrical science has taught us that if a varying magnetic field meets a coil of

wire, an electric current is generated within the coil and the coil becomes a magnet. If this magnetic coil is free to move, it will turn into the earth's magnetic meridian—into a north-south position. To do this, the coil in Doctor Russ' apparatus would have to overcome the force exerted by the magnet above it. This magnet, already in its proper north-south position, would object to being swung out of it. If, when the experimenter's gaze was directed on the coil, it moved against this force, it would prove the electric power of the human eye.

DOCTOR RUSS took his station a short distance from the metal case and began to gaze steadily through the window at the coil. One second—no movement. Two, three, four seconds—still no movement. Five seconds—the coil started to swing! Within 10 seconds it had turned several degrees toward a north-south direction, forcing the little magnet above it out of its proper position.

Doctor Russ looked away. The coil swung back to its east-west line. Deprived of the power from the eye, it could not keep the magnet from asserting its pull.

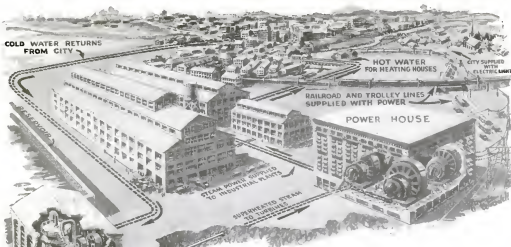
Continuing the trials with improved apparatus, Doctor Russ found that the first result had been no freak. For the wire coil he substituted a cylinder made

Wrestling with a Tiger

George Carrossella, noted animal trainer, playing with the most treacherous and dangerous of jungle beasts. You will notice that Mr. Carrossella always stares into the animal's eyes



(Continued on page 121)



The proposed plan to utilize the earth's interior heat. Dotted lines and arrows show circulation of water that is turned into steam in a chamber three miles down

Can We Pump Power from the Earth?

By Ernest Welbeck

WITH the rapid dwindling of the world's natural resources in stored fuel—coal, oil, and gas—engineers and scientists in recent months have been turning to the problem of tapping and harnessing the vast reservoir of heat in the interior of the earth.

The latest plan, and one of the most ingenious and elaborate, developed by Rudolf Laumel, a German engineer, is pictured here. It proposes drilling two shafts, one straight, the other with a number of rectangular bends, to a depth of three miles. This depth is about 2½ times that of the deepest shafts ever drilled. Both shafts lead to a large subterranean chamber cut out of solid rock.

If we estimate that with every 100 feet downward the temperature rises one degree Centigrade, the temperature of the walls of that chamber will be approximately 166° C. or 330° F. At a depth of three miles the air pressure is estimated at nearly two atmospheres, or about 30 pounds to the square inch. The boiling point of water under this pressure would be 248° F., more than 80 degrees lower than the temperature of the chamber.

FROM a reservoir on the surface, water is sent down through a pipe that follows the bends and turns of the stepped shaft to the chamber at the bottom. As the water rushes downward, it becomes gradually hotter, and at a depth of nearly two miles it turns to steam, which is forced into the chamber by pressure of the column of water above. In the high temperature of the chamber the steam is

superheated and expanded. It seeks an outlet through the straight shaft.

Reaching the surface, the superheated steam is distributed first to the turbines of a light and power station, then to various industrial establishments and to residences and public buildings, where it is used for heating purposes.

HAVING given up its heat energy, the water is collected again in a reservoir, from which it is pumped back to the pipe, resuming once more its voyage to the natural heat plant and completing the cycle—water, steam, water.

Even on its downward flow to the underground steam chamber, the water is put to work. At the lower end of each vertical section of the staggered conduit, a turbine driving an electric generator is inserted. The turbines in the upper two miles are water turbines; those in the remaining part of the shaft, steam turbines. The electric power thus generated is conducted to the surface to be used for driving pumps and other machinery required in running the heat and power plant.

The energy to be derived from a plant of this description, of course, depends on the volume of water available. Assuming that a constant flow of 13 cubic yards a second is obtainable, as it is in many existing hydraulic power plants, the potential energy made available by heating that volume of water to 330° F. would be equal to nearly 3,000,000 kilowatts a day, representing an economic value equal to 70,000 tons of good coal a day.

PUMPING PLANT—POWER SUPPLIED BY HYDROELECTRIC UNITS BELOW SURFACE

3 MILES

WATER RECORDING STEAM

STEAM CHAMBER (330° F.)

America's First Rotor Boat

Naval Officers Embody New Ideas in Odd Craft

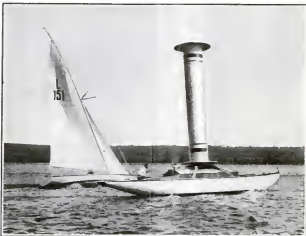
THE interest with which the strange rotor ship designed by Anton Flettner was greeted a few months ago, when it sailed out into the Baltic Sea, little surpassed that of the spectators who recently watched the trial voyage of the first rotor boat in America, on the Charles River at Cambridge, Mass. This American boat, constructed by two young naval officers, was the first actual demonstration in this country of how a revolving metal tower can replace canvas sails.

Lieutenants Joseph M. K. Kiernan and W. W. Hastings, students in naval architecture at the Massachusetts Institute of Technology, were greatly interested in reports of the rotor ship. They decided to build one for themselves. They acquired an abandoned navy cutter about 30 feet long and eight feet wide, and with discarded materials from other boats fixed up the rotor apparatus.

In designing the tower they used data gathered in exhaustive experiments in aviation at Langley Field, Va., where for some time the United States Army has been studying the application of the Magnus theory of air pressures to aircraft. The American boat employs the Magnus effect, just as the German boat does.

The Magnus principle, as applied to a rotor boat, may be expressed as follows:

The wind hitting the side of a rotating cylinder goes around with the cylinder. Decreased air friction on one side of the cylinder creates suction, and increased air friction on the other side causes pressure.



A spectacular race between new Flettner single-tower rotor yacht and a sailboat, staged recently near Berlin. The sailboat won. Flettner's first rotor ship had two towers.

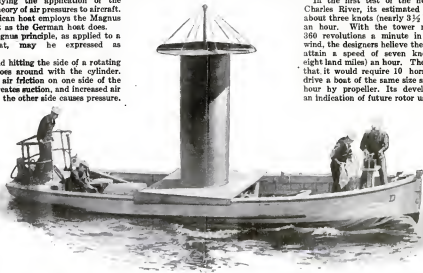
These two forces, together, move the boat.

The American boat differs in several respects, however, from Flettner's craft. While the German inventor used two cylinders on his 600-ton boat, the Americans decided to use only one on their cutter. They believed that when two cylinders were used, one interfered with the other's action. Flettner also apparently has come to this conclusion, for he

air from entering these zones from above and disturbing them. These rims revolved with the cylinders.

The disk used on the top of the American's rotor tower is stationary. The rotor tower is mounted in the middle of the boat on a ball-bearing base and is supported by an interior column. It is driven by a five-horsepower motor located at its base.

In the first test of the boat on the Charles River, its estimated speed was about three knots (nearly $3\frac{1}{2}$ land miles) an hour. With the tower rotating at 360 revolutions a minute in a 15-mile wind, the designers believe their boat will attain a speed of seven knots (about eight land miles) an hour. They estimate that it would require 10 horsepower to drive a boat of the same size six miles an hour by propeller. Its development is an indication of future rotor uses.



America's first rotor boat on its trial trip. It was designed and built from an old 30-foot naval cutter by two young naval officers, Lieuts. Joseph M. K. Kiernan and W. W. Hastings. Its estimated speed was about $3\frac{1}{2}$ miles an hour.



Where the Airplane Was Born

The original camp built by the Wright brothers in 1900 at Kitty Hawk, N. C., birthplace of the airplane. Orville and Wilbur are seen hard at work on one of their numerous experimental glider models, with a small boy as spectator

How a Twisted Paper Box Gave Us Aviation

By John R. McMahon

The Air Conquered

Wilbur Wright flying the successful glider of 1902. The operator, lying on his stomach and clutching the controls, had to shift his weight quickly to balance the craft and avoid a crash. The author of this article was one of the first to report the epoch-making experiments of the Wright brothers. He writes from personal experience and observation

WHEN Orville Wright announced last spring that he would present to an English museum the pioneer airplane in which he and his brother Wilbur made historic flight on December 17, 1903, there was quite a stir in this country and abroad. President Coolidge hoped that the machine might be kept at home.

There was promise of Congressional action, both to retain patent models in America and to investigate Mr. Wright's charge that the Langley relic in the National Museum at Washington had been refurbished improperly, manipulated and labeled to support a priority claim.

We can wait for Congress to clear up the Langley matter, which, after all, is a question of "might have" or "afterward also" rather than "did fly first." Meanwhile it is interesting to have a bit of light thrown on the yet obscure details of the Wright brothers' independent and marvelous achievement. Their story, despite world-wide publicity, is still to be told. One reason for this is the death of Wilbur, the elder brother, in 1912.



The First Wright Glider

The first actual heavier-than-air machine built by the Wright brothers, embodying their idea of warping. This glider flown in 1900 at Kitty Hawk. Its wing span was 18 feet, with a chord of five feet. This picture shows one of the experimental flights, with the glider used as a kite, operated by cords from the ground

The young bicycle men of Dayton, Ohio, had been discussing the problem of flight for about three years when the first real idea came to them in June, 1899. They had spent Sundays lying on their backs beside the Miami River, hoping to learn something from the stately maneuvers of hawks and buzzards in the blue overhead. Then came that first real idea, which was Orville's—to obtain lateral balance by hinged wings.

"The hinge is a good idea, but not practical," agreed the brothers after debate. This was their judgment as expert mechanics.

The bicycle shop that the young men conducted was kept open late evenings to cater to the trade of factory employees.

Wilbur was on duty one night in July, some weeks after the hinge concept had been argued and seemingly discarded.

A customer came in. If he had asked for tire tape, a wrench or a pump, the course of history might have been changed. But this customer asked for an inner tube for his bicycle tire. That tube was packed in a rectangular pasteboard box. Wilbur held the empty box by its ends while the customer examined the contents. Wilbur's hands were inclined to be nervously active. He looked down and suddenly realized what he was doing with an empty box—twisting it—warping it. What was this? Can't hinge wings? Never. But you can warp them! Eureka!

Wilbur closed the shop in a hurry and rushed home to tell Orville.

Usually each brother, in the interest of truth, savagely assailed the other's idea. This time Orville heard the box story, made no argument, and just accepted Wilbur's warping amendment to the hinge principle. Then and there one-half of the problem of lateral balance of the airplane was solved for all time. It was simply a great inspiration, like Newton's falling apple.

THE Wrights had a cozy home on Hawthorn Street and there was much affection among its four dwellers—brothers, sister and father. The mother had died some years before. Katharine had taken her place as far as possible.

Fascinating Glimpses of the Airplane's Birth Revealed for the First Time by One of the Early Associates of the Wright Brothers

Home love and unity were also factors in the birth of aviation. The "boys" always found their recreation and deepest enjoyment in the home circle. They tinkered around and improved the frame dwelling with their own hands, adding a porch among other things.

Within a month after the warping scheme came to them, the Wrights tried it out on a box kite that they flew from Seminary Hill in Dayton. A large audience of small boys heged to assist. The kite, a five-foot biplane, acted badly from the small boys' viewpoint—it scooted here and darted there like mad, but satisfied its makers, since it responded to the control cords that twisted its frame.

NEXT in order was to test the idea in a man-carrying glider, which the brothers started to build the following winter.

Wilbur pioneered the first trip to Kitty Hawk, N. C., in the fall of 1900 and on the way was almost wrecked in a fishing boat. Mrs. Tate, wife of the local postmaster, let Wilbur use her sewing-machine to stitch together the wing

coverings of the glider. In return for this courtesy it was only fair that next year the postmaster's little girls should be wearing very fancy dresses of cream-hued saten, made out of glider wings. And if those dresses still remain, they are certainly heirlooms!

The brothers had agreed to take turns in going up. Wilbur had the first ride, Orville holding a rope tied to the machine. How that winged broncho hucked! It danced, it cavorted. Alarmed by its gyrations at the dizzy height of perhaps 10 feet above ground, the co-sire of aviation yelled in his sharp staccato: "Lemme down! Lemme down!"

Afterward, when teased by his family for "Lemme down!" Wilbur always had an alibi, that he had promised his father to take care of himself; and every-

body, including himself, would laugh.

While the warping principle passed the test in pioneer voyages, the brothers now saw flaws in the classic air tables on which curves of planes and other things depend. Home again, they tried to solve the mysteries of air pressure with a whirling wind-vane attached to the front of a bicycle. A young man pedaling around Dayton with such a contraption naturally gave pleasure to spectators. One of the latter must have been clairvoyant of the secret purpose, for he was heard to state:

"That fellow can run his gizzard out, but he'll never make that thing go up!"

At a later period, amid a skepticism almost universal, the brothers found one true believer, Charles Webbert, landlord of their bicycle-shop quarters. It is

touching to think of this first convert—a landlord to boot. How it must have encouraged the young experimenters! They did thank him for his faith, regardless of its basis. It seems Mr. Webbert was a spiritulist and thought the brothers flew by aid of the spirits.

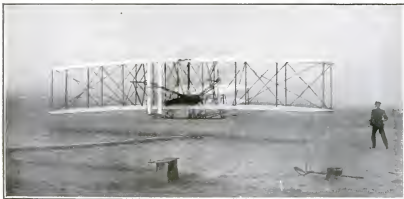
A larger glider was planned for the next year and again Wilbur stitched up the wing covers, but this time on the family sewing-machine and on the side porch of the Wright's home-stand. Any passer-by on Hawthorn Street could see that lean, sharp-eyed young man laying out muslin on the grass, snipping it in bias

(Continued on page 120)



In Camp at Kitty Hawk—A Room Full of Great Ideas

Interior of the shed camp de luxe at Kitty Hawk in 1902, showing Wilbur Wright at work on the glider of the previous year. In this camp Orville officiated as chef, running his kitchen mathematically

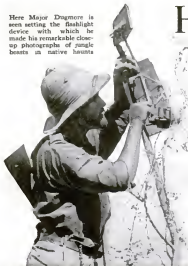


An Epoch-Making Moment—Start of the First Power Flight

This is one of the most prized photographs in the world. It was snapped at Kitty Hawk December 17, 1903, just as the Wrights' first power plane took the air at the end of its monorail runway. Orville was the pilot. As the machine started down the track and into the wind, Wilbur ran at the side holding the wing

to balance the machine. He was able to stay with it until it lifted after a 40-foot run. A member of the Kill Devil Hill life-saving crew snapped the camera an instant after the machine had left the track and had risen about two feet. Wilbur is seen still running at the side, watching the historic first flight

Here Major Dugmore is seen setting the flashlight device with which he made his remarkable close-up photographs of jungle beasts in native haunts



Hunting Wild Beasts by Flashlight

Thrilling Jungle Photos at Close Range

CAMERAS instead of rifles; flashlights in place of gunpowder—these were the hunting weapons used in the wilds of African jungles by Major Radclyff Dugmore, daring naturalist, artist, and explorer, in obtaining the remarkable photographs of big game pictured on this page. Only twice did he use a rifle, and that was when angry lions, whose pictures he was seeking, charged him. Major Dugmore's method was to find out the animals' own kill and lie in wait for the return of the killer, at a distance of about 10 or 12 yards.



Many nights were spent by Major Dugmore in the black depths of the jungle to obtain this remarkable flashlight picture of a spotted lioness



This lioness, returning to her own kill, suddenly spied the cameramen 10 yards away, who at that instant set off the flashlight

Below is an extraordinary picture of a wounded lion, one of two shot by Major Dugmore after they had charged him. This was taken at a distance of only eight yards from the roaring beast



A huge rhinoceros charging, photographed at range of 16 yards. When aroused, this is one of the most dangerous animals



Hippopotamuses, sunning themselves on the bank of a river, all unaware of the photographer

Still to Be Won!

444

Cash Prizes in Our Remarkable \$10,000 Contest

"I'VE been so busy making mistakes in a new home of my own that I haven't had time until now to worry about the mistakes of John and Mary Newlywed," writes a Detroit suburbanite. "Am I too late to try for a prize in your \$10,000 picture contest? And if not, how can I get in?"

No doubt others have let the weeks slip by since our great cash prize contest was announced in the June issue and are asking a similar question.

There is still plenty of time for everybody. Although the fourth and final set of "What's Wrong?" pictures appears in this issue, on the next two pages, there still remain exactly 444 out of the original 580 cash prizes to be awarded. That means that you have an equal chance with everybody else to win one or more of 444 prizes totaling \$8000.

The first thing to do is to turn this page and look at the eight contest pictures for September. The contest has to do with the enthusiastic but inexperienced efforts of John and Mary Newlywed to do odd jobs about the home they have just moved into. Each picture shows John or Mary doing one of these jobs in the wrong way. And in addition, our artist has deliberately drawn one thing in each picture incorrectly. What you are to do is to find what John or Mary is doing wrong, why it is wrong, and what mistake the artist has made.

You can practise on the picture at the bottom of this page, which was printed as an example, to show you how to go about the contest. First, what is John doing wrong? Obviously, he is varnishing a table in the smoke from the back yard incinerator. If you don't know, you can easily find out why this is wrong and how it should be done. Next is the observation test. What mistake has the artist made? What about the shadows? Is it right that the shadow cast by the varnish can should fall in a direction opposite to that of all other shadows?

THE eight pictures published this month form a complete contest in themselves. Similar sets of eight pictures appeared in the June, July, and August issues, making four complete monthly contests in all. And, in addition, there is a Grand Prize Contest in which \$6000 in prizes will be awarded for the best answers submitted for all 32 pictures in the four monthly contests. The last two of the monthly contests, as well as the Grand Prize Contest are still open for your entry.

You have until August 30 to submit answers to the pictures in the July contest, and you have

Your Last Chance to Win One or More of These Big Prizes

IN THE June issue we offered \$10,000 in 580 cash prizes for the best answers submitted in this contest. Of these prizes 444 still remain to be awarded. The prizes offered in each monthly contest are:

First Prize.....	\$500
Second Prize.....	\$100
Third Prize.....	\$50
5 Prizes, \$10 each.....	\$50
60 Prizes, \$5 each.....	\$300
Total, four months.....	\$4000

In addition, cash prizes in the Grand Contest will be paid as follows:

First Grand Prize.....	\$2500
Second Grand Prize.....	\$1000
Third Grand Prize.....	\$500
5 Grand Prizes, \$50 each.....	\$250
50 Grand Prizes, \$10 each.....	\$500
250 Grand Prizes, \$5 each.....	\$1250
Total Grand Prizes.....	\$6000

until September 30 to submit answers in this month's contest and in the Grand Prize Contest. If you have mislaid your copies of the June, July, and August numbers, and if your newsdealer cannot supply you, copies of these issues may be examined free at the offices of this magazine or in the public libraries. If you wish, you may obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.

It costs you nothing to enter. All you need is to be observant and alert. You can submit as many sets of answers to the pictures as you wish, and if you run into difficulties you can call on members of your family, your friends, or neighbors for assistance. But before you start to write your answers, be sure to read the rules of the contest. These you will find on page 122 of this issue.

THE names of the prize-winners in this month's contest will be announced by the judges in the February issue of POPULAR SCIENCE MONTHLY. Winners of the Grand Prizes will be announced as soon as possible after the close of the contest. Three judges, members of the staff of the Popular Science Institute of Standards, will decide on all awards.

Remember the final date—September 30. Better sit down now and write out your answers while there is still plenty of time. You are sure to find the contest fascinating and profitable.



Practise on This Picture

In this sample "What's Wrong?" picture, John is seen varnishing a table in the smoke of the back-yard incinerator. Why is this wrong? You will see, too, that the artist has made the shadow from the varnish can fall in the wrong direction

A \$10,000 Test of Observation and Alertness

What's Wrong in

In Each John Is Doing Something
Made One Error



1. John isn't satisfied until the garage door is padlocked against auto thieves. He purchases a harp and staple, and is seen here as he energetically tightens the last of the screws



2. Mary's desire for an extra shelf in the bedroom gives John another chance to use his new set of tools. Here he is starting the last screw in the angle bracket shelf support



3. This is John's first experience in removing a tire from its rim. But with the aid of a couple of tire irons and a hammer he sets boldly and confidently to work on the job



4. John loses no time in adopting Mary's suggestion for a catch-lock on the door. It looks so easy that he anticipates nothing but a perfect job when he has finished it

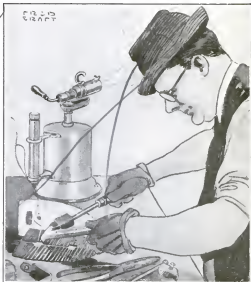
These Pictures?

Wrong, and in Each the Artist Has
in the Drawing

*Read the Rules
of This Amazing
Contest—Page 122*



5. The woodwork in the breakfast nook is too dark and gloomy, Mary thinks; so John gets a can of white enamel and starts enthusiastically painting the trim around the window



6. Mary's electric iron refuses to work. Taking it apart, John discovers that a wire is broken in the heating unit. Eagerly, though with little experience, he proceeds to solder the break

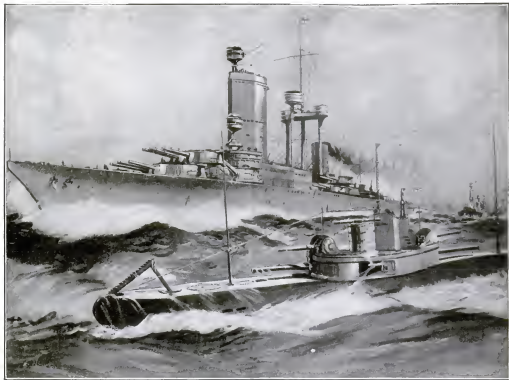


7. Though he knows little about electrical appliances, John determines to give the noisy electric fan a thorough oiling. Here he is undertaking the job with enthusiasm



8. Mary protests at the appearance of the radio storage battery in the living-room. Eager to please her, John conceals the battery in the closet and runs the wires under the rug

Marvels of Marine Invention



Latest Rivals of Naval Warfare

Despite repeated assertions by experts that the warship is doomed, warships still are being built on a larger scale than ever before. The latest type battleship, represented by the 30,000-ton *Nelson* and *Rodney* laid down in England, is 700 feet long, capable of steaming 24 knots, and carrying six 16-inch guns. It is pictured here, together with a German naval architect's recent conception of the modern battleship's greatest rival, the giant submarine cruiser



Two Boats in One

A racing sailboat with a double hull—two pontoons connected by cross braces—is the novel idea of an Italian inventor, Luigi Penco

A Floating Lighthouse

The floating brick residence shown at the right is one of the world's oddest lighthouses. It is located off the coast of New London, Conn.



Job"

Men at work in
son for the new
ing New York
agest tunneling
—sweet air pressures, a
good day's work is out an hour, for which the pay is \$12



Where Half an Hour Is a Day's Work

Thrilling Experiences of a Veteran Sandhog, Who for 30 Years Worked Deep in Caissons and Tunnels

By Frank Parker Stockbridge

"SURE I like it. Why shouldn't I? Short hours, big pay, an' easy work into the bargain. Who wouldn't like a job like that, I'm askin' ye?"

Paddy Ryan, veteran "sandhog," spat emphatically into the gutter as he delivered that eulogy of his day's work. Paddy was just through with his job in the Hudson River vehicular tunnels, the biggest tunneling project ever completed, with the twin 30-foot tubes making an under-water roadway for automobile traffic between New York City and the New Jersey shore. And being the biggest of all under-water tunnels, it was the biggest sandhog job on record. Twelve hundred of these men, doing their day's work below the river-bed, had burrowed those mile-long holes through the mud, and some of them—Paddy Ryan for one—were proud of their achievement.

From where we stood, in West Street on the New York water-front, we could see the towering steel skeleton of the city's newest skyscraper. The clatter of the pneumatic riveting hammers resounded like the tattoo of a flock of giant woodpeckers. Paddy took a long puff

at his pipe, removed it from his mouth and waved it in the direction of the sound.

"Now, them hoys," he said, with an inimitable burr that defies type, "them hoys takes their lives in their hands every time they goes to the top. When they fall they've got a long ways to drop. Now, us lads that works in the tunnels an' caissons don't take no chances like that. There ain't no place for us to drop. We're already at the bottom, an' then some."

Paddy laughed at his own joke. There was no doubt of his belief that the sandhog's job of sinking caissons and digging tunnels under compressed air was far superior to the risky business of climbing aloft among the beams and girders.

"Yes, sir," he went on, "there ain't no place for a sandhog to fall to, without he lets go of the ladder goin' down into a caisson, though I mind me of Dan Murphy that was killed by a wooden plug, no bigger than would stop a jug, fallin' 80 feet an' hittin' him on the head when he was at the bottom o' one o' the caissons o' the Manhattan Bridge, crossin'

the East River, at New York. Them was monsters, them caissons. Ever been down in one, mister?"

I pleaded ignorance. Paddy beamed with a superior air.

"IT'S like a big box with a top an' no bottom, a caisson is," he said. "At the top is the air lock, an' at the bottom is the muck—earth or sand or gravel or hardpan or rock—whatever stands between the surface of the earth an' bed-rock. Y' see, the purpose of the caisson is to clear everything away, down to the backbone o' the world, so they can have somethin' solid to rest their steel an' concrete on. What good would all that be if it wasn't on rock at the bottom?"

He waved his pipe again at the sky-scraper. "Them hoys wouldn't have no jobs at all if it wasn't that us sandhogs did our job first," he went on. "Now it stands to reason that when you get down a certain ways underground you strike water, an' that 's why you're got to use caissons, unless the bedrock comes above the water line. Ninety-four feet, them Manhattan Bridge caissons went down,

That's two ~~four~~ hours' rest between 'em. All sandhog jobs are two shifts, for nobody can stand the pressure for a full workin' day. An' the higher the pressure, the higher the pay an' the shorter the day. In caisson work the pay's a hit higher, and there's seven kind o' days, one for pressures up to 18 pounds an' eight hours' work; the next is six hours, from 18 to 26 pounds, an' so on up to pressures above 48 pounds. That's some pressure! An' how long do you think a day's work is under that much air? Half an hour! Two 15-minute shifts, that's all. But the pay goes up 50 cents a day for every step up in pressure, so a miner—that's me—gets 3½ dollars on top of his eight-fifty, for half an hour's work. Twelve dollars for 30 minutes!

"IT AIN'T often we have to work under top pressures, though! Deepest job I ever worked on was the Pennsylvania tunnels, from the Jersey shore to the Pennsylvania Railroad terminal in New

York. That was only about 40 pounds pressure."

Paddy paused and relighted his pipe nonchalantly. Evidently working "under air" agreed with him. Unlike the structural-steel workers, few of the sandhogs are of the slender, wiry type. They run rather to fat than otherwise, and Paddy Ryan is no exception to the rule.

"Sure we get fat, an' why wouldn't we?" he responded to my comment. "Man, what an appetite it does give you, workin' under air! A company doctor explained it to me once. It seems it's because we inhale more oxygen every time we breathe the compressed air than we do on the surface, an' it's the oxygen that hurns out the waste in our blood an' tissues. There must be somethin' in that, for any kind of a fire hurns faster under the air. My pipe, now—three puffs an' it's hurned out, under 30 pounds pressure. They don't stand for smokin' on the job, though. A sandhog that does is blacklisted. In the old days,

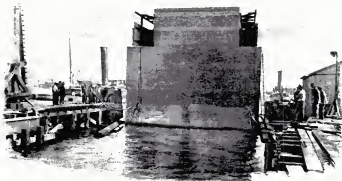
before the ~~compressed air~~ ^{compressed air} was everywhere to work with, an' we had to use candles, a candle would hurn out in no time. Sometimes after a candle was blown out it would light up again from the spark on the wick, just because of the oxygen.

"SAY, that reminds me of a funny thing," Paddy went on, after a few reminiscent puffs at his pipe. "There was a sandhog named Louis Cassari, an Austrian. He was an old-timer, and he held the record for the longest time under air—16 hours, under 30 pounds. Well, Louis hlew out his candle in the caisson one day an' put it in his pocket, an' you can call me a Dutchman if it didn't light up again in his pocket. First Louis knew about it was when he felt his leg hurnin', and there was his pants half hurned off!

"Yes, sir; it's the oxygen in the compressed air that hurns up the food we eat, so we have to be sure to eat enough. An' I suppose it's the same thing that makes it easy to work under air. Kind o' like a stimulant; everything's easy to do. Fellows that are too lazy to shake down the kitchen stove'll do a big day's work in a caisson or a tunnel an' think nothin' of it. You don't get tired at all."

"Pretty dangerous work, though, isn't it?" I ventured. "Doesn't it knock a man's system to pieces, if he keeps it up?"

"You're thinkin' about the 'bends,' that there used to be so much about in the papers," replied Paddy. "Well, it's the same with this sort o' work as with any other—a man's got to take care of himself. Everybody has to. You have to, don't you? Well, then, a sandhog that doesn't take care of himself off the job'll die sooner than the ones that does, hut



One of the big steel caissons for the vehicular tunnels, towed into position for sinking

there's nothin' in workin' under air to hurt a fellow. Look at me, now. I've been workin', caisson an' tunnel jobs, on the other side an' over here, for 30 years, an' I'm good for 20 years yet.

"TAKE your time in the air lock, especially comin' out, an' don't let the lock-tender change the pressure too fast, an' you're all right. There's an air lock at the top of the caisson or the shore end of the tunnel. When you go in, they close the door behind you, an' turn on the air till it gets up to the pressure inside the workin'. Comin' out, it works the other way. Goin' in you can take it faster than comin' out; that's where the boys used to get into trouble and get the 'bends,' comin' out of the air too fast. Thirty seconds in the air lock for every pound of pressure is the rule, but sometimes a sandhog that's in too much of a hurry'll turn the valve when the lock-tender isn't lookin'.

"That's not much this side o' murder, for while it might not hurt him, it might kill some o' the rest o' the gang in the lock, or cripple 'em for life. That's when you get the 'bends'; by comin' out too fast. It's like the jumpin' toothache an' the worst kind o' rheumatism combined, an' if it hits you in the head you go daffy. If it gets you in the belly you have the worst colic you ever heard of. There's only one way to cure it, an' that's to go under the air again, and ease off the pressure gradual. It's little hubbles of air that gets into the blood, under the pressure. They work out through the lungs if you give 'em time."

Paddy's pipe called for attention again. There was the far-away look in his eyes

...done my
...he said. "I was
...for Jimmy Sullivan, the best
foreman I ever worked under. He was
an old-time sandhog, only they call 'em
all miners over there. He'd worked in
the caissons of the Forth bridge an' come
over here, once, in 1890, when an English
company was tryin' to run a tunnel
under the Hudson, the one McAdoo took
hold of afterwards an' finished—what
they call the Hudson Tunnel now.

"Well, we had the tunnel through,
though the air was still on,
while we was puttin' in the
lining, when two members
of the London County
Council thought it would
be a nice thing to make a
tour of inspection. They
were fat, red-faced blokes,
retired soapmakers or some-
thin' like that, an' their
idea of an inspection tour
was to bring a big hamper
of lunch along, with some
whisky an' champagne to
wash it down with, an' eat
lunch in the tunnel.

"WELL, the air pres-
sure was so heavy
the champagne cork
wouldn't pop, but had to
be pulled out, an' they were
complainin' about how flat
the stuff was. It wouldn't
fizz at all. But they drank
it, or one of 'em did. The
other stuck to whisky, an'
emptied about half the
bottle. Then they went
back to the air lock. I was
goin' off shift, so I was in
there with 'em.

"Pretty soon, as the

Then you come out of 90 degrees at
end of your shift an' maybe it's around
zero outside, but you're so hot you don't
notice it at first, an' you don't wrap
yourself up like you ought to. Then you
get a chill an'—good night!"

"But what about the risk of drowning?"
I inquired. "Don't the caissons and
tunnels get flooded, sometimes?"

"A fellow has to take some chances on
any job," replied Paddy; "but it's no
worse on this job than on any other—

(Continued on page 125)



Sandhogs bolting together the great cast-iron segments
that form the lining of the great under-river tunnel

EVERYBODY who drives a motor-car or rides in one is familiar with the "speed limit"—the rate beyond which the law says a motor vehicle may not travel.

Has Nature, though, also her speed limit? Is there a rate beyond which a human being may not travel without breaking one of Nature's laws?

In other words, could a man operate an airplane or a motor-car at a speed of 1000 miles an hour, say, were science to produce a vehicle capable of going that fast?

It is doubtful, says science. The thousand-mile-an-hour airplane is mechanically possible, but there are speed limits set up by nature beyond which the human body cannot go. Various physiological processes of the body are the traffic cops that will force man to obey the speed laws of nature, no matter how fast he may build his vehicles, no matter how ambitious he may be to surpass previous speed records.

These physiological processes issue unmistakable warnings in the form of pain, dizziness, nausea, and even unconsciousness, when man approaches the speed beyond which he may not go. To proceed faster would be suicide.

WHEN Lieut. Al Williams, U. S. N., former big league pitcher, reached the unprecedented speed of 266.59 miles an hour in his airplane, not long ago, he heard the warnings of the traffic cops of nature.

"When I rounded a turn," he reported, "I went out cold."

And there, according to science, is the hub of the whole matter. The straight-away speed that man can stand may not yet have been approached; but it is likely that Lieutenant Williams came very close to the rate at which nature will permit a man to speed and turn.

When a high rate of speed, it is thrown over on his side quite as so. as if he were cast from a catapult. The circulation of the blood must adapt itself to the sudden change of position. It is slow to do so. The body is going one way; the blood is circulating in a way that corresponds to quite a different motion of the body; the result is dizziness.

Moreover, centrifugal force draws the blood away from the brain. There results a condition known as brain anemia. At 266 miles an hour the brain's blood supply can readjust itself. At 1000 miles an hour, though, science says, the terrific pull would draw the blood from the brain with such force as to result in permanent injury, possibly death.

Major L. H. Bauer, of the School of Aviation Medicine, Mitchel Field, N. Y.,

Jim Davis setting the world's speed record of a mile in 32.53 seconds. The motorcycle's possible speed, like the automobile's, is also limited by the road it has to travel.

is one scientist who is ready to predict that excessive speeds will cause permanent injury or death.

What nature's speed limit for the human body is, Doctor Bauer says it is impossible to state. But there is a limit, and probably it never will be reached because of nature's warnings.

When Al Williams made 266.59 miles an hour—a mile in a little more than 13 seconds—he traveled faster than a human being ever went before or since. Other aviators have approached that speed, but



More than Three Times Faster than Man

The racehorse Cherry Pie, which holds the world's record for a competitive mile, made this distance in 1 minute 35 2/5 seconds. Men's best record for the same distance afoot is 4 minutes 10 2/5 seconds.

Can YOU Go?

*New Discoveries Show that Nature,
Not Mechanics, Limits Man's Speed*

By Robert E. Martin

in no other vehicle has anything like such a speed been attained.

The closest approach to it, according to official records, is the mile in 23.07 seconds that Tommy Milton made in his automobile. Automotive engineers believe that automobiles never will travel much faster than that. It is not a question of making a car mechanically capable of attaining the speed; it is a matter of obtaining a road on which such a speed can be negotiated with comparative safety.

THE same factor probably limits the possible speed of motorcycles. Though motorcycles are used by the police in keeping automobile speeders in order, so far as speed records are concerned, the motorcycle must take second place to the automobile among vehicles that travel the road. For the fastest motorcycle speed recorded is a mile in 32.53 seconds made by Jim Davis.

Mechanical vehicles—whether in the air, on the ground, or in the water—make the efforts of man to attain speed through his own muscles seem quite ridiculous. Thus, while man has succeeded in traveling a mile in approximately 13 seconds in an airplane and 23 seconds in an automobile, the best time that Paavo Nurmi, the last word in runners, has been able to make for the same distance is considerably worse than four minutes. Charley Paddock, probably the fastest consistent runner that ever lived, can better Nurmi's best speed, but only for a short distance. The dizzy speed that has carried this



He Came Close to Nature's Speed Limit

When Lieut. Al Williams, U. S. N. (right), reached the unprecedented speed of 165.59 miles an hour in his airplane, he "went out cold" at a turn—evidence of nature's speed limit



The Greatest Sprinter

Charley Paddock, probably the fastest runner that ever lived, has traveled 100 yards in 9 3/5 seconds; yet he could not maintain such speed, for the farther man goes, the slower his pace must become



His Car Traveled a Mile in 23.07 Seconds

The nearest approach to the fastest airplane speed is the mile in 23.07 seconds, made by Tommy Milton (above) in his automobile. Automotive engineers believe that automobiles never will travel much faster than this record. This remarkable picture shows Milton's car traveling at top speed

California athlete 100 yards in 9 3/5 seconds cannot be maintained by him for a mile—or even for an eighth of a mile, for the farther man goes, the slower he goes.

In the water, man's speed depends entirely on his method of navigation. In a motor-boat he can reach express-train speed. The speed of the greatest swimmer, however, cannot be compared with the speed of the average walker. Thus Johnny Weismuller, who has eclipsed all records at the shorter distances, required 51 2/5 seconds to make 100 yards in his best effort.

A fish, of course, could circle round and round this greatest of swimmers and beat him at any distance. Similarly, most animals can eclipse the best speed of which man is capable afoot. Thus, Cherry Pie, the racehorse, which holds the world's record for a competitive mile, accomplished the distance in 1 minute 35 2/5 seconds. Nurmi's best record for the same distance is 4 minutes 10 2/5 seconds.

With some mechanical aid, man can better that latter time. Thus, Reggie McNamara has gone a mile in 1 minute 45 seconds on a bicycle, while Arthur Staff has made a mile in 2 minutes 35 seconds on ice skates.

There seem to be very definite limits, though, to what man can accomplish with his muscles. Only a small fraction of a second usually separates the new record from the old.

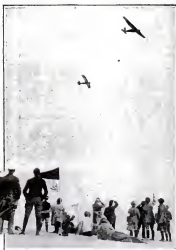


One of the new gliders soaring over the sea after a running start down a hillside against the wind

Sea Gliders—the Last Word in Aircraft



The pictures on this page were taken during a recent German contest for new types of motorless gliders capable of sustained flight and of alighting on the water. The picture at the left shows a biplane glider wrecked on the beach after the pilot had attempted a sea landing



Two contesting gliders in the air. The one at the left flew for eight continuous hours before landing



Above: A glider skimming the water's surface in making a perfect descent. At the right: How the contesting machines were hauled to the scene of competition by teams of horses. Note the absence of landing gear and the fishlike body of the glider, a monoplane



Poisons that Lurk in "Bootleg Booze"

*Federal Chemists Reveal the Perils of
"Imported" and Homemade Liquors*

By Norman C. McLoud

LET the national water supply become as foul as hootleg liquor, and the population will be in a state of complete panic.

In this circumstance lies one of life's mysteries. Civilization balks at drinking polluted water. The mere suggestion of impurity brings consternation and dismay. A hint of typhoid germs in the water supply will terrify an entire community.

Bootleg liquor, though, is a different proposition.

Ninety-nine per cent of the stuff is off color. Much of it is the sort that kills. Not more than one quart in a hundred meets the standards of the days preceding prohibition. More than that, much of it contains actual, active poisons, among them carbolic acid, formaldehyde, pyridine, acetone, and iodine—chemicals that are used in denaturing the alcohol from which much of the hootleg stuff is fabricated and which the hootleg manufacturer cannot remove when attempting to turn the denatured alcohol into a beverage.

Lye is another poison that is found in hootleg booze. Lead salts, zinc salts, and tin salts, absorbed either from the distilling apparatus or from the containers in which the stuff is shipped, frequently appear in the weird liquors that are sold for genuine Scotch.

prices for the privilege.

This is not propaganda. The statements are cold facts, stripped of argument, and based on scientific research. They are the product of applied chemistry seeking the truth about the national liquor supply. They are facts unbiased by personal opinion on the prohibition question.

There is a government laboratory in Washington that devotes itself to the job of learning what's in hootleg booze. I have lived with the chemists in this laboratory. I have seen them taste "hootleg"—as a part of their day's work—and spit it out as they would the rankest poison. In the process of observation I have seen them cheat death by seconds through the simple expedient of getting rid of the stuff before it could get them.

"We learn to taste without swallowing," government chemists explained to me. "Chemical analysis is exact, but



"Less than One Per Cent Is Genuine"

Dr. W. V. Linder, chief of the Chemical Section, U. S. Internal Revenue Bureau, examining typical specimens of moonshine. In the last year Dr. Linder and his chemists have analyzed more than 85,000 samples of bootleg liquor. "Less than one per cent of the stuff now sold," he says, "is genuine liquor."

there are some questions that it does not answer. The sense of taste must be employed also. We can taste the contents of 25 or 30 bottles without swallowing a drop. If we did swallow it, there would be daily vacancies on the payroll."

In my study of contraband booze I have enjoyed contact with Dr. W. V. Linder, chief of the Chemical Section of the Internal Revenue Bureau. In the last year Doctor Linder and his chemists have analyzed more than 85,000 samples of hootleg liquor.



Spirits?

...poured from a
this alleged
...was pure an-
...rently a safe

The addi-
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"Less than one per cent of the stuff now sold," Linder told me, "is genuine liquor. Despite all you hear on the coasts about liquor that is 'just off a ship,' or in other parts of the country about liquor that has 'just been smuggled across the border,' or fraudulently withdrawn from a bonded warehouse, 'hootleggers' simply can't get hold of the 'real stuff.' The supply today is made up of moonshine, distilled under the most filthy and insanitary conditions imaginable, or mixtures of denatured alcohol, colored and flavored to represent whisky, or containing juniper to make it pass as gin. That this stuff is not as pure as before must be conceded.

"Poison? Of course. The degree of poison varies, but it is there just the same. Some of the stuff kills immediately. We have had gallons and gallons here, one drink of which might have meant death. Other mixtures might be drunk regularly for months perhaps before the poisons became effective. Sooner or later, though, they would become effective.

"The death certificate of the drinker might not show hootleg liquor as the cause of death, but it would be the

cause nevertheless. For the effects of many of these poisons are cumulative. They attack the liver or kidneys; undermine the entire system.

"It has been claimed that hootleg liquor is no more harmful in this respect than the alcoholic beverages consumed in other days. This contention, though, is wrong. The harmful effects of the present type of liquor are far greater."

Linder has a staunch ally in the official person of J. M. Doran, head of the Prohibition Unit's Industrial Alcohol and Chemical Division. Doran backs the statements of the chemical chief and makes startling declarations of his own.

"MUCH of the whisky, gin, and kindred drinks peddled by bootleggers," this expert told me, "have as their basis either moonshine, with its attendant poisons, or denatured alcohol, a non-beverage liquor intended for industrial use. The latter consists of pure grain alcohol to which has been added various denaturants rendering it unfit for beverage purposes."

"These denaturants are impossible of elimination by any process employed by the hootlegger. The majority of cases of instant death from alcoholic poisoning are the results of drinking this class of concoction."

"Wood alcohol produces paralysis and atrophy of the optic nerve, with total blindness, inflammation of the kidneys and bladder, nephritis, and cystitis. In some cases it produces death. It is known that death has been caused by as little as three ounces. Detection of the presence of wood alcohol is impossible except by thorough analysis performed by a skilled chemist in a well-equipped laboratory."

"This product is diluted, flavored, and colored, bottled in containers bearing fake caps, labels, and stamps, and sold as well known brands of liquor."

IN THIS last statement is found the tack that punctures the consumer's bubble of security produced by familiar labels. Nobody should let himself be fooled by an honest appearance on the outside of the bottle. Counterfeit packages are the essence of the hootlegger's trade.

"Almost every brand of label has been imitated," Doran told me. "Whether domestic or foreign, the labels have been made and sold by the tens of thousands. Few labels known to American consumers have been overlooked."

One source of supply for fake materials was discovered in the shadow of the United States Capitol. In this establishment the representatives of the Treasury Department found a stock of merchandise that constituted a bootlegger's delight. There could be obtained any desired variety of bottle he might require—

exact counterparts of the bottles that designated various brands before liquor became an outlaw.

Dressing the bottles received the same careful attention at the hands of this enterprising dealer. His counterfeits included labels, tinfoil, stoppers, and everything that might be required for giving the bottle an honest appearance. Even the packing was not overlooked. The supplies embraced the peculiar Scottish nails used overseas for fastening

Not long ago a rum ship was captured, which contained a complete outfit for fabricating "Scotch" of almost any desired brand—There were alcohol, flavoring chemicals, bottles, labels, corks, cases; everything that was required to give the appearance of genuineness to the ship-made liquor.

From at least two points—one in New Jersey and the other on Long Island—bootleg "Scotch" made on United States soil, I am told, is transported regularly to the rum fleet by motorboat and carried back again by the rum-runners and disposed of as imported stuff.

THE hootlegger is a good advertiser. Much of his prosperity arises from stories sent broadcast regarding the large amount of liquor being smuggled into the United States, and similar stories of large amounts fraudulently withdrawn from bonded warehouses. These stories, though, Linder, Doran, and Roy A. Haynes, Federal Prohibition Commissioner, assured me, were made of the same material that supplies the body of much of the liquor that is peddled these days—moonshine.

"It is almost impossible to get real liquor," said Doran. "Even though it may have been real once, it does not remain that way for more than a few hours after coming into the possession of the hootlegger, for the hootlegger is not going to lose fabulous profits by selling good liquor 'as is' when he can dilute or 'cut' it with re-distilled denatured alcohol, wood alcohol, or coloring matter, and make of it four or five times the original amount."



In the Storehouse of Fakes

J. W. Quillen, Uncle Sam's chief in the New York laboratory, with his huge store of bottles. Many of the bottles bear familiar labels, but, however, contain fakes of which is poisonous.

the cases in which they are packed for export. They were also on hand to see this merchandise in labels and in the world's chain.

Even when they come out of the government guarantee—

Shoe-Leather from the Sharks

*Remarkable Fish-Hide Industry
Developed by New Process*

THE increasing scarcity of mammal hides in recent years has caused leather manufacturers to turn to the sea for their raw product. Today, largely through experiments under the direction of the U. S. Bureau of Fisheries, the skins of sharks, porpoises, and other fish have been developed into excellent leather. For this purpose shark fisheries have been established on the Florida and Gulf coasts, and new industries are being established to utilize the new product.

This has been made possible largely by a process of tanning developed in the laboratory of Dr. Allen Rogers in the Pratt Institute of Brooklyn, N. Y., and pictured on this page. One company, it is reported, now is turning out 200 shark hides daily. The hides are made into high grade waterproof leather that can be used just as ordinary leather. There is said to be as much leather value in a shark as in a cow, and the cost of a fish is far less:



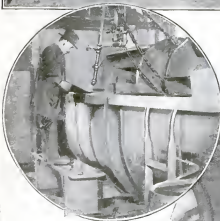
Perfects New Tanning Process

Dr. Allen Rogers of Brooklyn, N. Y., discoverer of a new process for making commercial leather from shark skins, in his laboratory testing the finished leather



**One Haul of
Sharks**

Special tared nets, 600 yards long, with four-inch barred mesh, are used to catch the sharks. With this apparatus from 50 to 200 sharks are taken daily



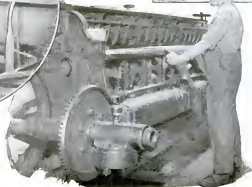
Washing the Fish Hides

In the new tanning process the shark skins are soaked for 24 hours, then washed thoroughly in large vats, as shown above. After this, they are left in a weak solution of caustic soda or lime for two days, being stirred occasionally, and finally they are washed a second time



The Polisher

After the skins are treated and dried, they are shaved on the grain side to remove coarse projections or denticles. Then, with the machine shown above, they are polished on a rapidly moving corborundum wheel



Softening Hides

On the machine at the left the hides are made pliable. Some of them are given a gun-metal finish suitable for shoes. Others are tanned for lining leather and cordovan



LIKE a wild-animal trainer, in a cage full of potential death, "Slim" Hoffman makes high explosives obey his commands. His is the most dangerous job on the movie "lot." Upon his skill often depend the lives of hundreds of actors. "The only trick," he says, "is knowing what your explosive will do, then timing the mixture with the action of players and that of the camera."

He Has Staged More Battles than Napoleon

How "Slim" Hoffman Makes Dynamite Do Astonishing Tricks for Movie Thrillers

By Fred Gilman Jopp

A BLINDING flash lights up the inky horizon. Another! The shriek of shells with stunning crash of detonation. The numb earth throbs. Flames! Destruction! Horror!

The deathly silence that follows is broken only by the grinding click of cameras striving to catch the last thin wisp of smoke. The movie battles over.

Not long ago a big freighter, formerly the S. S. *Corvallis*, sailed serenely off the coast of Sandy Hook. A man watched over a switchboard. He pressed a key. Half an hour elapsed, as the movie captions say, and floating bits of debris were the only token of the vessel that had been shattered and sunk. Ten tons of dynamite and 1000 pounds of gunpowder had done their work. All to provide a moment's thrill for you some night at the movies!



Blowing Up a Steamship for a Thrill

Ten tons of dynamite and 1000 pounds of gunpowder—set off by one man with the pressing of a key—produced this spectacular explosion of the steamship *Corvallis* a few weeks ago off Sandy Hook. And all to provide a moment's thrill for you in the movies

One man blows up a huge steamship. A single man creates the carnage of a whole battle in the movies. He is a powerful person and important for he plays with the most dangerous tools on the "lot." On his skill often depend the lives of hundreds of actors.

Here is the time to introduce Walter J. ("Slim") Hoffman, screenland's explosive engineer, the man who has staged more battles than Napoleon, but who differs from the Little Corporal in that he has yet to cause his first casualty. Hoffman can make dynamite do a whole bagful of tricks.

Everything has changed in motion picture production, including methods of destruction. Movie sets used to be razed by pulling wires or cutting ropes. This never was satisfactory, because human beings all react differently. The pull of wires or the chopping of ropes never was uniform, and time after time a building would fall halfway and then stop in mid air because some rope or wire had caught on a projection.

Then the method of using fuses came in. While this was an improvement, still it was unsatisfactory, because fuse



A Movie Bombardment of a French Village

Shell, shrapnel, and other gunfire are produced with remarkable realism by the explosive engineer through skilful blending of his powder mixtures

would go out at the wrong time. Often when a whole building was to be razed, one portion of it would remain standing because the explosive failed to explode. Accidents occurred from delayed fuses, causing serious injuries in some cases.

Today explosions are created by electricity and powder. All parts of a building can be destroyed simultaneously, or any portion of it without disturbing the rest. Or explosions can be timed to act consecutively, giving film effects that

startle. So long as the powder is of a certain chemical quality a certain mechanical result is assured. There are no chances of accidents under these modern conditions.

The explosive engineer must construct a Civil War or a modern battle at three days' notice. The problems that greet him each day would drive another engineer crazy. An idea of what he is up against may be gleaned from the following assignments. The list is typical of the jobs "Slim" Hoffman finds waiting for him when he comes down to the lot in the morning.

1. Destroy the brick laboratory on the hack lot without harming the two glass stages 100 feet distant.

2. An explosion in which a trick cigar explodes in the villain's mouth to blind him, and at the same time shatters the glass of poisoned wine held by the aged father.

3. A projectile breaching through one wall, must travel between two actors and out the other wall.

4. A man off balance, about to fall down a man-hole, must be set back on his feet by the concussion of an explosion set off below. No tricks.

5. Destroy an entire French village with explosions that give the effect of shrapnel fire.

This is a good begin-

ning. All the secrets of solving these difficult problems are locked away in the explosive engineer's brain. "There is really nothing to them," Hoffman told me with a laugh. "The only trick is knowing exactly what your explosive will do, then timing the mixture with the action of players and camera.

"THE great difficulty is with the human element. Powder will do what I command, but the players sometimes won't, and the result is grief, and lots of it. Actors, like almost all other people, have difficulty in mastering the psychology of fear. Any one can walk 20 feet on a curbstone, but lift that curb 100 feet in the air, and it's a different story.

"It is the same way with explosions. We can point out that the explosion will affect only a certain area, that physically it can spread no farther, but reasoning does no good when an actor is afraid. Usually, in such cases, the director and I get around things by keeping the explosion a secret. In this way I can guarantee positive results, and the director obtains registration of honest-to-goodness emotion. Imagine your favorite star standing near a couple of sticks of dynamite, and that dynamite exploding without her knowledge! Does she register fear and amazement? I'll say she does!

"The wise director, however, shoots the explosive scene at the very end of the picture, because after the explosion the star is likely to be a little shaky. And you can't blame her. But when this picture is shown and the critics rave over the star's great emotional work, you can

(Continued on page 132)



By ingenious placing of explosives, any part of a building can be destroyed without disturbing the rest. Behind the camera sits Hoffman, watching for the exact moment to throw the switch that will "shoot" an explosion where a moment before stood an actor

Drift-Recorder Keeps Pilots on Course

An Ingenious New Aid to Aviators

AVIATORS throughout the world are interested in recent successful tests of an instrument, invented by Commander Le Prieur of the French Army Aviation Service, that enables pilots to determine exactly the deviation of their craft from its course as the result of side winds. This instrument, called the "navigraph," makes it possible for the pilot to reach his objective in the shortest time possible.

The principle of the navigraph is explained in the accompanying diagram. Supposing an airplane should start from A on a course A X, with the intention of reaching B, with the intention of

reaching B. If it were exposed during its flight to a side wind blowing in the direction BC the airplane would find itself at the end of a calculated time at C, having actually traveled along the drift line AZ, though pointed in a direction parallel to AB.

If we assume that the airplane, flying in still air, would have covered the distance AB in one hour, the line AB in the triangle would represent the speed an

hour of the airplane. The vector BC represents the speed and direction of the wind in miles an hour, and the vector AC represents the course actually followed by the airplane and its speed an hour in relation to the ground. The angle BAC represents the deviation due to the wind.

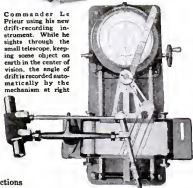
Knowing the speed of his airplane and the direction and distance of his objective, the aviator needs only to know the angle and direction of his drift to enable him to lay out a course that will unerringly take him to his destination within a calculable time. The object of Le Prieur's navigraph is to provide a simple method of determining the drift angle.

The navigraph consists of an instrument for determining the direction and angle of side drift, and an apparatus for plotting corrections of the line of flight. A small movable telescope is mounted to form one side of an articulated parallelogram. The other side is formed by a tube with a pencil at one end. The axes of the pencil tube and the telescope always remain parallel. The point rests on a recording paper stretched between two rollers.

To determine the angle of drift, the

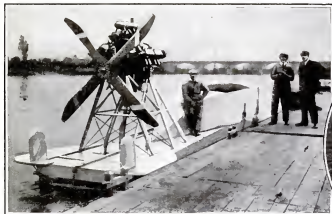


Commander Le Prieur using his new drift-recording instrument. While he sights through the small telescope, keeping some object on earth in the center of vision, the angle of drift is recorded automatically by the mechanism at right



aviator sights through the telescope some distant point along the line of flight. By keeping that point in the center of the field of the telescope, and drawing a line along the edge of the calibrated ruler mounted on a disk in a parallel position, the aviator will obtain a pencil-line record indicating the angle of drift.

French Air-Propelled Sea-Sleds Race a Mile a Minute



While high power motor-boats have been matching their speed against express trains in the United States, a remarkable new type of racing craft, driven by airplane propeller, has appeared on the Seine River in France. It is called a "sea-sled." A number of these boats, racing under the auspices of the Motor-Boat Club of France, are reported to have attained the remarkable speed of a mile-a-minute.

Below is a front view of the sea-sled speeding across the waves. The close-up view at the left shows how the motor and propeller are mounted securely on a framework above the stern deck of the flat, streamlined craft



New Aids for the Deaf

Compact Amplifiers Replace Ear Trumpet



Dr. Byron E. Eldred demonstrating his remarkable new vibrating instrument for the deaf

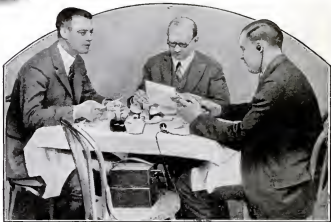
TWO highly ingenious devices for the relief of the deaf recently have been developed by scientists.

Dr. Byron E. Eldred, mechanical engineer, of New York City, is responsible for the apparatus pictured above. The operation of this is based on the fact that deaf persons often can hear sounds ordinarily inaudible to them when the sounds are accompanied by loud noises, such as the rumbling of a train, or the beating of a drum. This phenomenon, scientists believe, is due to the fact that vibrations of the louder noises act as a sort of "carrier wave" for the smaller voice vibrations.

Doctor Eldred's device, by means of two generators that actuate a diaphragm, sends out a succession of air vibrations, corresponding to the rumble of a train or similar noises, and these are said to aid deaf persons to hear ordinary conversation.

Another device to aid the deaf is a miniature telephone receiver developed by engineers of the Bell Telephone Laboratories. This fits into the ear, and is virtually invisible. With its connecting cord it weighs only six-tenths of an ounce. It is connected

with a microphone that can be worn in the coat lapel, and an amplifier in a box that can be carried in the hand. The amplifier contains two small vacuum tubes and the necessary batteries. By the use of this device, which is called the "audiophone," a person who has lost 60 per cent of his hearing is said to be able to hear the ordinary conversational tones of a speaker three feet away.



How the miniature telephone, called the "audiophone," is used by a deaf person. The instrument is so small that it fits in a person's ear. The amplifier is seen on the chair

Automatic Wireless Instrument Sends "SOS" Calls at Sea

THAT the radio operator of a ship may have a chance for his life with the rest of crew if the vessel should sink, a new SOS sending device has been invented to give automatically the ship's call sign, the latitude and longitude, and the distress signal. After the machine has started it will continue sending out the call until the ship sinks, according to the inventor, M. Passaquin, a young French engineer.

No operator is needed. Dials on the

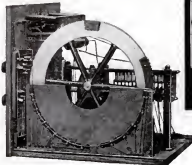
machine may be set each day according to the ship's location so that everything may be ready in case of accident.

The instrument, operated by a small electric motor, is contained in a cabinet and may be mounted on a table. It con-

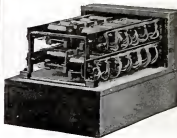
sists of a wheel with notches all around its rim and a shaft bearing 14 cams.

The notches on the rim of the wheel transmit the three dots, three dashes, and three dots of the SOS signal. These are sent three times in succession, and then follows a long space that allows for the sending of the ship's call sign. The latitude and longitude are then sent by the cam arrangement, which has 14 cams, 10 for digits and four for compass points. The control panel is arranged with dials for the various settings.

Seacraft equipped with this invention does not need radio operators on board in order to send out messages of distress.

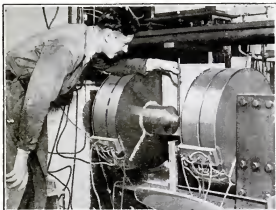


The control panel of the automatic SOS transmitter, with dials for the various settings, is shown above. Notches on the rim of the revolving wheel shown at left transmit the dots and dashes of the signal. At the right is an automatic receiving instrument



Sun-Gazer Forecasts Weather

*Other New Discoveries
and Useful Inventions
that Mark the World's
Achievements in Science*



World's Most Powerful Magnet

For use in testing the atomic theory in metals, this huge magnet, said to be the most powerful in the world, was installed recently at the Engineering School of the University of California at Berkeley.

ALMOST every day of the month there are produced new inventions or discoveries to lighten human labor, relieve suffering, add to our comfort, or increase our knowledge of the world we live in. Are you keeping in touch with them? Do you know of their value to you?

The following brief survey of the month's important achievements will help you keep up to date in the rapid progress of science and invention.

The Sun as an Almanac

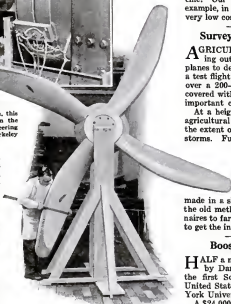
ONCE every day for more than a year Henry H. Clayton, meteorologist, formerly official forecaster in Argentina, has been looking at the sun through a telescope, and forecasting, from what he has seen there, the temperature of the day one week following, in New York City. He mails his predictions to the Smithsonian Institution in Washington the day he makes them.

Recently, in checking up his method of forecasting weather by the sun, Smithsonian computers announced that for the year Clayton's predictions, on the average, worked out remarkably well. Bright patches on the sun, called "faculae," or numerous sun-spots, mean that a hotter sun is coming, Clayton explains. An increase of solar heating, contrary to what one might expect, means cooler weather in the East.

The methods of forecasting now employed by the U. S. Weather Bureau produce only general predictions of the "fair and warmer" type.

Antiseptic Rays Purify Water

TWO scientists in Paris recently dropped a bottle containing an antiseptic in a vessel of impure water. The bottle was tightly corked so that its



The Biggest Airplane Propeller

Measuring 16 feet across, this immense airplane propeller was constructed recently in Milwaukee, Wis., for one of the planes that soon will attempt a round-the-world flight from Seattle. It is declared to be the largest aircraft propeller ever built, and is designed to travel 1100 revolutions a minute.

contents could not come in contact with the water. Yet 24 hours later, when the bottle was taken out, 25 per cent of the microbes in the water had been killed.

The account of this amazing experiment conducted by Doctors Techouyres and Bunau-Varilla was made recently before the French Academy of Sciences. An explanation advanced is that the antiseptic gives off rays that attack microbes, just as ultra-violet rays do. The tube that contained the antiseptic, a weak solution of chloride of lime, was made of quartz, which apparently let the rays through readily.

Out of 60 tests, 51 showed that the microbe colonies had been reduced nearly 30 per cent after 24 hours' exposure to the antiseptic, without contact. The consequences of this experiment may be of

great importance for hygiene and medicine. Our city drinking water, for example, in the future may be purified at very low cost without chemicals.

Survey Crops by Airplane

AGRICULTURAL observers are trying out the plan of going up in airplanes to determine crop conditions. In a test flight recently, an army plane flew over a 200-mile area in North Carolina covered with tobacco, peaches, and other important crops.

At a height of from 50 to 200 feet an agricultural statistician was able to note the extent of damage done by insects or storms. Further, he was able to determine by the color of the crops and soil the general healthiness of the crops.

In an airplane an estimate of crop conditions over a large area can be made in a single day, it is said, while by the old method of sending out questionnaires to farmers, it often takes 10 days to get the information.

Boosting Aeronautics

HALF a million dollars has been given by Daniel Guggenheim to establish the first School of Aeronautics in the United States. It will be a part of New York University in New York City.

A \$24,000 prize is being offered in England for the design of a moderate priced, low powered, light airplane for popular use. It must be a two-seater, dual-control plane of British construction, with folding wings and an engine that weighs not more than 170 pounds.

Coffee and Alcohol

COFFEE is more of a stimulant than alcohol. The latter makes a man stupid. It is depressing and paralyzes all proper fear and restraint. While those under its influence can do more work, they do not do it well. On the other hand, coffee is stimulating, enabling a user to work beyond normal strength, although he must pay the penalty later in loss of sleep. These statements were made by Dean Henry H. Rushy, of the Columbia College of Pharmacy in New York City, explaining why the world drinks what it does.

Another Columbia University professor, Dr. H. L. Hollingworth, put six college students to a two weeks' drinking test to find an answer to the question: When is a man intoxicated? In courts all sorts of tests are used, from making a man

walk a chalk line to repeating the alphabet backward.

Alcohol was included in the students' diet on certain days without their knowledge, and their conversation, conduct, appearance, and attitude were observed carefully. The results showed, according to Doctor Hollingworth, that psychological tests are the best method of detecting intoxication. These measure steadiness, speed, and control by testing the subject's ability in such things as tapping with a pencil and adding.

Catfish Lives 50 Years

HOW long does a fish live? Not out of water. Any boy can tell that from observation. But with proper food—everything it needs?

Major F. S. Fowler, of England, who has been conducting a special study to find out, reports that a catfish with which he is acquainted is now 50 years old and is still lively. An electric eel in the London Zoo, he found, lived 12 years. Other fish age figures, as given by Major Fowler, are as follows: carp, 13 years; goldfish, 12 years; herring, four years; salmon, three years; brown trout, six years. A bullfrog's recorded age was 15 years; toad, 11 years, and the giant salamander, 52 years.

Lung Capacity and Health

PUFF out your chest, but don't be too proud of yourself. Large lung capacity does not mean, necessarily, that you are healthy. Dr. J. A. Meyers, of the University of Minnesota Medical School, reporting the results of six years of study of lung capacity, says that it is by no means a certain test.

The man with the barrel chest may have done hard labor, engaged actively in athletics, or sung baritone in the choir. Any of these things would have increased his lung capacity. At the same time his lungs may be diseased.

Many persons who were known to have 125 per cent or more of normal lung capacity, Doctor Meyers' study revealed, developed diseases of the heart or lungs. Later examination showed the disease decreased the lung capacity of the individual, while it still left him with more than 100 per cent, or normal, capacity.

Insects of Past Ages

TSETSE flies, carriers of the germ of sleeping sickness, fatal to men and cattle, have



To find a way of preserving marble in its original beauty, the U. S. Bureau of Standards recently installed this testing machine, which subjects samples of marble tiling to vigorous scrubbing with various cleaning fluids. Dr. W. Kessler, in charge of the laboratory, is seen holding a piece of the marble in his hand after it had been cleaned in this way.

been found in Colorado. Fortunately, they are dead and have been so for one or two million years. They are fossils, found recently in rock deposits near the foot of Pike's Peak by expeditions under T. D. Cockerell of the University of Colorado. Strangely enough, not a trace

can be found of house flies, stable flies, or blue-bottle flies. There is no evidence that the monster beasts roaming over Colorado in prehistoric days, were hothoused by these pests.

U. S. Indian Population Gains 22 Per Cent

THE "poor Indian" is holding his own in the United States. Instead of dying out,

as is popularly believed, the Pueblos and other tribes are increasing at a rate nearly as high as that of the white population.

A census just taken shows that in the last 10 years the population of Pueblo villages increased more than 22 per cent. During that same time the entire population of the United States increased 39 per cent, and part of that was due to immigration.

Dr. Edgar L. Hewett, a well known archeologist, who has been studying the Indians, denies that disease is appallingly prevalent.

"Banana Myth" Refuted

WHEN Columbus arrived in America, there were no bananas here. They were introduced 24 years later from the Canary Islands. Early migrants carried them to the Pacific Islands, but they first grew in the Malay Archipelago on the other side of the world.

Doctor W. E. Safford, economic botanist of the U. S. Department of Agriculture, made these statements recently in refuting what he calls the great "banana myth." That is, that bananas originated in this hemisphere and were cultivated here in prehistoric times by the Indians.

New Method of "Painting"

"PAINTING" buildings with light is an inexpensive and effective method invented by engineers in Fresno, Calif. The walls are made of cream-tinted terra cotta or pressed brick and flood-lighted with colors such as soft magenta, ruby, or emerald. Wonderful "dream pictures" are said to result.

Ancient Bread

LOAVES of bread 2000 years old were dug up recently in Egypt.

Hate of Noise Won Him a Fortune



Alden L. Putnam, of Lansing, Mich., inventor of the popular balloon tire

BECAUSE he hated noise, he patented one of the world's richest inventions. Alden L. Putnam, of Lansing, Mich., invented balloon tires to stop the chatter of his car.

Rearched in the peaceful New England countryside, he enjoyed quiet instinctively. And so later, when he drove his car over railway tracks or uneven roads near Detroit, the rattle of the machine irritated him. As superintendent of an automobile factory he did his best to quiet the noises of cars turned out of the plant.

During the war Mr. Putnam served with the U. S. Motor Transport. The noise of the heavy army cars exasperated him. Finally, one day, he gave a tire a spiteful kick. It replied with a loud thump.

The inventor rushed back to his garage. He had discovered the source of road noise. He put huge tires on the wheels of his car—34 by 7 inches. The rims were not made for these, and the tires were ruined. He tried another set, and persisted until he had perfected his big tire.

Mr. Putnam applied for a patent on his balloon tires in 1920, but it was granted only this year. Within the last 18 months balloon tires have become standard equipment, and from his passion for quiet it is predicted the inventor will reap a fortune.



Ingenious Revolving Eraser Holds Paper Cutter

FOR draftsmen, architects, builders, typists, and others who have occasion to make frequent erasures, sometimes from important papers, a new type of revolving eraser has been invented by James F. Hayes of Chicago. Pressing the thumb on a plunger produces an erasing surface of more than four inches.

An attachment to the eraser sharpens pencils, opens envelopes, cuts paper, and erases ink.

Chance Leads to Valuable Find in Tire-Repairing

EMIL NESTLER, of New York City, thought a new car that had gone through a fire. The tires, as well as the body of the car, were somewhat damaged by fire and in attempting to repair these burned tires, Mr. Nestler had a curious experience. One of the five tires gave remarkable results after he had retreaded it, but the others suffered from the loose threads that so often end the usefulness of retreaded tires.

In experimenting to find out why the one tire should lend itself so readily to a retreading job, Mr. Nestler stumbled on a process for retreading tires that appears to eliminate the many defects in former processes. The chief trouble always has been the difficulty in keeping the new tread from parting company with the carcass of the tire. By Nestler's process the surface of the old rubber is reduced to unvulcanized rubber so that when the new tread is applied and the tire retreaded, the new rubber fuses with the old and a perfect bond is formed.

The inventor, Emil Nestler, demonstrates his new process of retreading. The new and old rubber fuse



MANUAL-TRAINING students at a Cincinnati public school built this map of South America. When the teacher presses a switch, all of the sections of the country producing rubber, say, are lighted up simultaneously. There are switches for nitrates, fruits, silver, and other products of the southern continent.

The map is used in studying economic geography in this case, but of course other classifications and arrangements of switches could be arranged.

EVERY person in the United States has the equivalent of 48 slaves. There are 700,000,000 mechanical horsepower developed in this country and the average work capacity of one human being is one-eighth horsepower.



Hat Held On by Vacuum Button when Wind Is Blowing

A CLEVER manufacturer has devised a means whereby he claims a straw or felt hat sticks to the head, tight as a mustard plaster, in a stiff gale. The device consists of a small molded button fastened to the hat through a buttonhole in the front of the sweatband. When the hat is placed on the head, the button sticks to the forehead on the vacuum principle. The grip is out of sight when worn, and is said to be comfortable.

German Zoo Uses Rum as an Anesthetic for Animals

WILD animals in captivity occasionally require surgical operations, and until recently the accepted practice of the veterinarians who performed them was to use chloroform for an anesthetic. Animal surgeons in the famous Hagenbeck Zoo, near Hamburg, Germany, however, have discovered that animals submit to surgery better when drunk than when subjected to the usual anesthetics.

Accordingly, when now a lion, or a tiger, or a hippopotamus needs a little dental work or other surgical attention, it is fed huge quantities of rum or cognac. Then, when it sinks into a drunken stupor, it is chained, and the surgeon performs his work with no pain to the patient or danger to himself.

Electric Pointer Illuminates School Map



Electrically operated map in classroom of a Cincinnati school. Pressure of electric switch at bottom of map illuminates section of the country that is the subject of class study.

Scientists on the Trail of a New Element

THE announcement was made a few weeks ago that three German chemists, Drs. Walter Noddack, Ida Tacke, and Otto Berg, have discovered two of the remaining unknown elements of the periodic system, Nos. 43 and 75, and have named them "masurium" and "rhenium." Both elements are exceedingly rare and constitute one-billionth part of the earth's crust. Hafnium, No. 72 in the total list of 92 elements, was discovered about a year ago. Numbers 61, 85, and 87 still are unknown.

The element No. 61 is believed to belong to the rare earth metals. Doctor Lapp, a noted American chemist, has succeeded in observing faint lines of the spectrum of element No. 61, and it is highly probable that the element will be isolated in the near future.

A New Distress Signal Fits in Palm of the Hand



Simple distress signal

HERE is a brand new distress signal called the "stressinal." With it you may scare away a handit or hurglar, but it can't hurt him.

It makes a lot of noise by firing blank cartridges—10 of them—in rapid succession, and its inventor claims that the noise is heard easily half a mile away.

This big surprise for the hold-up man fits in a woman's purse and may be carried in the palm of the hand ready for action as pictured. Pressing the button with the finger starts its rapid-fire action. If you let it drop from the hand it keeps on firing and the would-be handit flees in terror.

Removing two small screws opens it for reloading with 10 more blanks, and then it is ready for another attack.

Folding Baby-Carriage Fits in Suitcase



The folding carriage as a dolly buggy. The upper picture shows the small size into which the carriage collapses.

A BABY-CARRIAGE that, when folded, can be carried like a hand-bag or in a suitcase is the latest development of the collapsible carriage. The "Dinkie," invented in England, weighs only 14 pounds. The body is of pliable waterproof material, supported by a rigid framework.

It can be used, also, as a go-cart, a cot, a high chair, or baby's bath. Thus a father can carry in one hand furniture enough for baby's needs during the week-end outing.

A NEW method of mosquito prevention consists in mixing oil with sawdust which, when "sowed" on the water, sinks, and releases oil for four or five days.



Six-Surface Razor Strop Lasts a Lifetime

THE difficulty of keeping the surface of a razor strop in good condition has been solved by an English inventor, who has designed a razor strop with six surfaces actually forming three stropps in one. When one section has worn out, it is cut off at the ends, and the next section used for stropping.

The base of the stropps is made of a fiber composition specially treated with a dressing that is said to give the razor a good edge without injuring the blade. The inventor claims that this many-sided strop will give a lifetime of service to the user.

Jumping-Jack Shoes Provide Thrills for Children

LEAPING through the air like a kangaroo is the exciting sensation offered to children by the recent invention of shoes with springs. These novel exercising toys are strapped to the feet in the same manner as roller skates, and the wearer can walk, run, jump, or dance on them.

The steel springs, while of unusual strength, are extremely elastic. The effect produced is said to be like walking on air. Each shoe has two spiral springs. The lower end of each spring is fastened to a sole that prevents the springs from injuring carpets or marring floors.

With a little practice, it is said, a child can make enormous leaps.

Engineers Move a 280-Foot Bridge in London

IN THE rebuilding of the famous Waterloo Bridge in London, a remarkable engineering feat was accomplished recently, when a 280-foot span of the temporary steel bridge was moved bodily for a distance of 93 feet.

The span was moved along steel girders by eight men turning winches that slid the giant framework and its 500 tons of weight at the rate of four feet an hour.

The historic Waterloo Bridge, which has been weakened by the sinking of its central pier, may be destroyed.



Homemade Haircut Improved by Neck-Shaving Guard

IF YOU could manage to shave the back of your neck, the home barbering stunt would almost pass as professional. Getting their wives to do it is the solution for some men but, in strict confidence, this doesn't always work out satisfactorily.

W. C. Bridges of Muscatine, Ia., has invented a neck-shaving guard to solve the problem. It consists of wire adjustable to any desired shape of neck trim. The wire is covered with a rubber tube, and is held in place by an elastic band that fits around the head.

Offers Huge Cash Prize for Morphine Substitute

ONE hundred thousand dollars is the dazzling prize offered chemists to induce them to discover how to manufacture a cheap substitute for morphine. The discovery must be made within the next five years. Herman A. Metz, of New York City, is making the offer in the hope of doing away with the drug evil.

Morphine is now derived from opium. If it could be made synthetically, much cheaper than that derived from the poppy, Mr. Metz believes that the supply of opium would be killed at its source. It would no longer pay to grow the poppy.

The magic formula, if discovered, must be guarded very carefully to keep the drug from being manufactured and spread among addicts.

Disk Points Warn of Poison Bottle in the Dark

A PRICK means "look out." Fumbling in the dark through the medicine chest, where poison should not be kept, but often is, a person cannot make a fatal mistake if the poison bottle is equipped with the new type of safety stopper illustrated.



The warning comes from a metal disk with sharp projecting points, which is held to the bottle by pushing the cork through it.

Danger in Spoiling Your Dog

TREAT your dog as a dog and not as a human being, warns Dr. Minas Joannides of Minnesota. Dogs may carry tuberculosis, diphtheria, scarlet fever, measles, smallpox, and rabies. They are subject to tapeworm and often carry fleas, ticks, and lice.

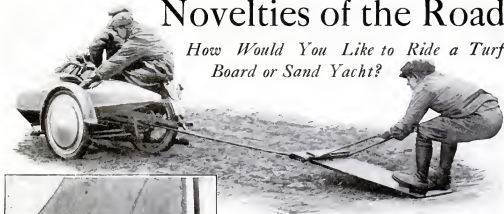
If you make a dog a member of your family, be sure to keep him clean and train him to avoid contact with infected materials, says Doctor Joannides. Don't let him eat off your plate.

Boys using the new spring shoes to play "leap-frog." Notice the soles attached to the bottoms of the springs to give sure footing and prevent floor marks.



Novelties of the Road

How Would You Like to Ride a Turf Board or Sand Yacht?



"Turf-Board" Riding Newest Motor Sport

At a recent cycling exhibition at the Crystal Palace, London, participants displayed their skill on surf-boards attached to motorcycles. While "turf-board" riding is said to be not quite as difficult as "surf-board" riding, it is considerably more uncomfortable and bumpy.



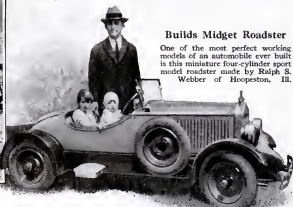
Sand Yacht Runs on Wheels

Clipping along through the salty spray, Miss Joan Mitchell, an English golf star, drives her rubber-tired "sand yacht" over the wet, smooth beach at Ayr. Her pet dog rides in the small back seat.



A Mechanical Roadway

This "mechanical highway," consisting of four rollers under the rear wheels, facilitates adjustments under load.



Builds Midget Roadster

One of the most perfect working models of an automobile ever built is this miniature four-cylinder sport model roadster made by Ralph S. Webber of Hoopston, Ill.



Traffic Signal also Supplies Time Warning

By a mechanism that slowly draws a veil over the "stop" and "go" signs, this new traffic signal tells drivers how much time is left to cross the street before the stream of traffic will start in the opposite direction.

Where Fire-Fighters Go to School

Thrilling Feats Test Their Nerve



Having mastered the use of scaling ladders, pupils in the Fresno firemen's school learn to support themselves on the ladders with both arms free, using safety belts fastened to the ladder as pictured above.



Above: How the firemen learn to carry an injured comrade down a life rope from an upper floor of a burning building. Center: Jumping into a life net from a sixth-story window.

THE fire department of Fresno, Calif., claims the distinction of having the only school for the training of firemen outside the City of New York. Before any applicant can go on the payroll as a

full-fledged member of the department, he must pass through weeks of intensive training in breath-taking feats of rescue. He must learn to scale the walls of skyscrapers with steady nerves; to carry the

dead weight of human bodies down from precarious heights on swinging ropes; and to jump from sixth-story windows into a life net that is spread below. A few of the daily paces that not only test the courage of novices, but train them in the science of fire-fighting, are pictured above.

Miss Liberty All Dressed Up for Birthday

AMERICA'S Goddess of Liberty has been granted independence. Congress decided recently to designate the statue as a national monument and make a special appropriation for its upkeep. Before this, the great torch in New York Harbor, given to the United States by France, was under the custody of the Quartermaster's Corps of the U. S. Army.

Miss Liberty's yearly allowance will be about \$7000. Ninety per cent of this is needed to pay her lighting bill. Two hundred and fifty-six flood lights flash on every evening as the sun sinks below the



An airplane view of the Statue of Liberty on Bedloe's Island. At right electricians are seen working on the huge torch held in the hand of Liberty.



horizon. These go out at 11 o'clock, but the torch remains illuminated until sunrise.

To celebrate her fortieth birthday, her custodians decided to give the goddess a bath. Steeple-jacks and other aerial acrobats were hired and she was scrubbed thoroughly from her gigantic head to her massive feet with brushes and heavy streams of water until she shone.

Railroad Runs Buses

THE New York, New Haven & Hartford Railroad has gone into the motor business and will operate bus feeder lines to the railroad in Massachusetts, Rhode Island, Connecticut, and New York.



New Type Battering-Ram Aids Firemen in Fighting Blaze

FREQUENTLY the hardest part of the fireman's job is to get at the fire so as to be able to play the hose on it. This novel two-man battering-ram has been developed by the New York Fire Department for use when it becomes necessary to batter through a wall or ceiling in order to get at the fire.

Ordinarily, an ax can be used for this purpose if the structure is of wood, but the heavy battering-ram will be far more effective than an ax for use on concrete and steel construction. Practical tests by the Fire Department already have demonstrated the remarkable efficiency of this device.

New Synthetic Motor Fuel

ONE more fuel possibility is a new synthetic alcohol known as "methanol," imported from Germany. It is a wood alcohol produced from coal and water, and is a result of researches carried on in Germany during the war, to find a substitute motor fuel.

Pipe-Wrench Has a Reversible Jaw

IT IS claimed that the pipe-wrench shown at the right will turn a pipe in either direction with ease, no matter how tightly it is set. The jaw can be taken out and reversed so that it is an easy matter to get at any pipe, even when it is placed very close to a wall, ceiling, or floor or when it is jammed up against other pipes.

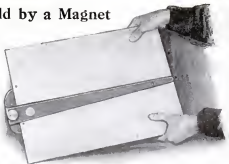
COAL - MINE explosions are most likely to occur between six and nine A.M., and between three and seven P.M.



An adjustable jaw makes wrench especially useful

T-Square Held by a Magnet

THE short cross piece of this remarkable T-square incloses a powerful permanent magnet. A piece of steel is set into the edge of the drawing-board and ground absolutely flat and square. The magnet is so powerful that it is claimed it will hold the T-square tightly in position even when the drawing-board is held up edgewise as shown in the illustration at the right. Because of the smoothness of the steel surfaces, it is said that the T-square can be moved along the drawing-board just as easily as without the magnet.



T-square is held to drawing-board by magnetized cross pieces

Setting brads is made easier by this tool's magnetized tip



Brad Setter Eliminates Hammer when Fastening Packing-Box

CONCEALED inside this remarkable little tool is a powerful magnet. Pulling the outside sleeve toward the handle with the first two fingers exposes the end of the magnet and when the magnet is touched to the head of a brad and the sleeve released, the magnet draws the brad into the tube.

The next operation is to force the brad into the wood by pressure on the handle. The brad is held straight so that it cannot bend and the plunger pushes the head slightly below the surface of the wood so that sealing-wax can be applied if, for instance, the box contains an article of considerable value.

"Electric Hand" Lays Bricks

ALMOST human in its motions is an electric gripper that stacks bricks on a truck ready for the kiln. This machine has rows of grippers, which in reality are electric fingers. The grippers are attached to the bottom of a segregator suspended from a crane. As the freshly made bricks travel from the brick-making machine, the rows of grippers pick up a brick in every "hand," and deposit them, spaced evenly, on the truck.

Novel Flexible Tipped Soldering Iron



Because of its flexible tip, this 100-watt soldering iron is invaluable for mending delicate and intricate parts, such as are found in a radio set

IN RADIO work especially, it often is difficult to reach the parts that are to be soldered, because the body of the iron strikes some other part in the set. The novel electric soldering iron shown at the left is said to overcome all difficulties along this line because the tip is arranged in a swivel joint so that it can be turned in any direction. It is rated at 100 watts and consequently is suitable for all kinds of work except in cases where a heavy duty iron is necessary.

Parking Tower for Autos Saves Ground Rent

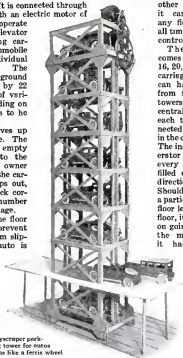
A MOST ingenious parking tower for autos was invented recently by J. E. Morton of Purdue University, Ind.

It consists of an all-steel tower in which a central drive shaft is connected through a train of gears with an electric motor of sufficient power to operate an endless-chain elevator of multiple parking carriages, each automobile having its own individual parking carriage. The tower covers a ground space of only 16 by 22 feet, though it is of variable height, depending on the number of cars to be parked.

A car-owner drives up to park his machine. The operator brings an empty parking carriage to the floor level, the owner drives his car into the carriage, locks it, steps out, and is given a check corresponding to the number of his parking carriage.

Guide rails on the floor of each carriage prevent the automobile from slipping; and each auto is protected also from drippings from the auto above it.

Merely by reversing the motor, the operator can bring a carriage to any floor level by



Skyscraper parking tower for autos runs like a ferris wheel

the shortest possible route. The carriage at the top passes over and comes down on the opposite side, while at the bottom it goes under the floor and comes up on the other side of the tower; it can be stopped at any floor level and is at all times under the instant control of the operator.

The parking tower comes in several units—16, 20, 30, 40, and even 50 carriages. One operator can handle a battery of from five to 10 parking towers installed in a large central parking station, as each tower may be connected with an indicator in the central control room. The indicator tells the operator the exact location of every carriage, whether filled or empty, and the direction of its travel. Should he attempt to bring a particular carriage to the floor level, and it pass the floor, it would simply keep on going until he reversed the motor and brought it back to the right position. Nor could the owner enter it until it was safely stopped for him, when he could go in, unlock his machine, and hack out into the street without delay.



Auto-Bus Has a Sliding Top

A SIGHTSEEING trip through the Big Tree district of California is spoiled if tourists cannot see the majestic height of the great trees.

In order that no detail of the scenery be lost, a fleet of sightseeing cars operating in this part of the Yosemite is equipped with tops that can be rolled back. In case of a sudden shower the central section may be replaced quickly.

Hungers for New Inventions

I ALWAYS have had a leaning toward new inventions, and your magazine supplies exactly what I hunger for.—W. W. Reidsville, W. Va.

Tractor Uses Rubber-Tired Wheels for City Trips

FROM Germany comes the good-looking automobile shown below. It is intended primarily for use as a tractor on a farm, but with the addition of the rubber-tired wheels it can be used as an ordinary car and taken into the city without fear of injury to the roads.



Farm tractor is equipped with rubber-tired wheels for city streets



Engine for Hauling Lumber Is Made of Junk

WHAT is probably the strangest homemade locomotive in the world is in use at a logging-camp in the woods of British Columbia, Canada. E. J. Byfield put together a few junked motor parts and produced an engine, which is mounted on a set of ordinary flanged traction wheels. A few yards of linked helting provided the necessary pulling power.

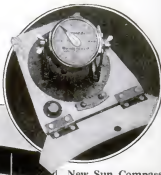
The locomotive runs on a specially constructed wooden track and loads of lumber are hauled in a trailer.

IT RECENTLY has been discovered by investigators into the subject that a plague of mosquitoes in certain localities is due to poor engineering practice in the construction of highways, railways, and reservoirs. Uneven surfaces, crevices in a loose joint and in walls provide hatching holes for the pests.

Latest Novelties in Aviation

Balloon Targets

They look like toy balloons, but the big bubbles at the left really are targets used by army aviators at Crissy Field, San Francisco. As the balloons float in the air the fliers pepper them with bullets from machine-guns

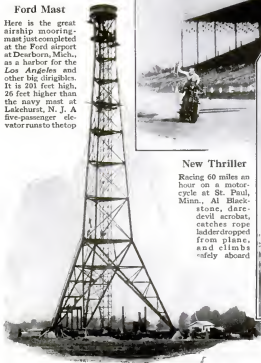


New Sun Compass

Because of inaccuracies in magnetic compasses in the polar regions, each of the airplanes of the MacMillan Expedition this summer is equipped with this new instrument that gives directions accurately with the aid of the sun

Ford Mast

Here is the great airship mooring-mast just completed at the Ford airport at Dearborn, Mich., as a harbor for the Los Angeles and other big dirigibles. It is 201 feet high, 26 feet higher than the navy mast at Lakehurst, N. J. A five-passenger elevator runs to the top



New Thriller

Racing 60 miles an hour on a motorcycle at St. Paul, Minn., Al Blackstone, dare-devil acrobat, catches rope ladder dropped from plane, and climbs safely aboard



England Has Air Glider Races

Model gliders in recent cup races of the British Society of Model Aeronautical Engineers at Sudbury, England. An article in the July POPULAR SCIENCE MONTHLY described in detail how to build successful gliders of this type



The light boat can be carried by one man easily. It is shown here in use as a sailing canoe and as a campers' tent.



Odd Sailing Canoe Serves as Tent

New Collapsible Boat for the Sportsman

A REMARKABLE collapsible sailboat that can be carried in a bag has been designed recently to answer the demands of the sportsman. Made of vulcanized rubber and canvas stretched on a wooden framework, it is very light. A man can carry it easily even when it is fully set up. It is hult in sections and can be assembled in 10 minutes, the inventor claims.

The sails are perhaps the most interesting part of the equipment. There are two, one twice as large as the other. The mast for the larger one is stepped at the forward end of the cockpit, and the other fastened through the deck at the back of the cockpit.

When the sails are fastened to a ridge pole set up in the middle of the cockpit, they may be converted into a tent or boat cabin. Or if the camper prefers, he can

set up the tent outside of the boat beside the stream, and use the boat as an ordinary canoe.

Comfortable seats with backs are provided. The combination canoe and sailboat will carry four persons, although, as in the case of any canoe, greater speed can be obtained when paddling if a lighter load is carried.



Ideal for the Embryo Mechanic

The word "Popular" is very significant, for at my home it is a contest between my three sons and myself to see who gets the first look. It is an ideal magazine for the embryo mechanic, to say nothing of the articles of a scientific nature that are most interesting to those who like to know.—Dr. B. C. W., Normal, Neb.

Stilts Are Carpenter's Stepladder

CLIMBING up and down a stepladder was not to the taste of the Paris carpenter shown at the right. He worked fast and was always having to move his ladder.

As a boy his favorite sport was walking on stilts. He still had a pair. He got them out and found them a splendid ladder substitute. The foot supports are adjustable to various heights.



Golf Club Prevents Slicing

AN AMATEUR golfer of Boston, John T. Manning, has invented a new club, a driver, which he claims cannot slice the ball. Vertical grooves fluted to correspond with the curvature of a golf ball are molded on the club's face. When the ball is struck, the ridges catch and drop it into one of the grooves, preventing motion sideways.



Carpenter using stilts as a substitute for stepladder



Stool Folds into Handbag

WHEN folded, this collapsible stool becomes a lady's handbag, as shown in the inset. It has a pocket on the outside for handkerchief and purse, and is fitted with a small mirror. After the stool is unfolded and before it is set up, the cushion on the seat is filled with air.

It is designed for use at picnics, in automobiles, on camping expeditions, or in crowded railway stations.



New Drawing Device Trains Student's Eye

TO TRAIN the eye of the art student in form, proportion, perspective, value, and color, Anson K. Cross, of the school of the Museum of Fine Arts, Boston, has invented a device the use of which introduces a new and easy method of studying art.

The device consists of a sheet of clear glass protected in a frame that holds a spirit level, and a white card that slides behind the glass. Two lenses slide between the lower members of the frame. These are used in painting.

The student draws on the glass with a special crayon. When the sketch is finished, he removes the opaque white card and views his drawing superimposed upon the model. The faults of the drawing

are made clear. By constant use of the lenses to test sketches drawn from memory or observation, the student trains his eye to observe accurately and report form and color.



Collapsible bathing-tent is made of rubberized cretonne

Occupant Serves as the Pole of Portable Bathing-Tent

A TREELESS bathing-bench offers no inconvenience to the bather who carries a portable bathing-tent of cretonne, a recent invention from London. It has the shape of a bag with a top section that fits on the bather's head like a hat. It envelops the whole body to permit a change of clothes, the bather himself supporting the tent.

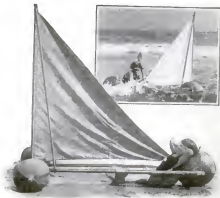
Discovers Moonlight Speeds Growth of Bacteria

GROWTH and activity of bacteria can be speeded up by the sort of light supplied by the moon, T. F. Morrison, graduate student at Princeton University, has discovered through experiments on the kind of micro-organisms that cause dead fish to shine in the dark. This work appears to confirm results obtained previously by E. G. Bryant, in South Africa, who found that fish exposed to moonlight spoiled more quickly than those kept in the dark.

Bottomless Sailboat Is Built for Use of Bathers

NO USE to haul water from the bottom of this sailboat! It cannot be done. It is intended for the use and pleasure of bathers.

A sail and three floats resembling huge basketballs make up the principal parts of the pleasure craft. Strips of canvas stretched between two horizontal poles serve as seat and support for the feet. A double-headed paddle is provided.



A sail, three floats, and a canvas seat make an interesting toy for the seashore frequenter

Child's Chair Is Adaptable to Many Games



Wheelbarrow train, or kiddy-car can be made from this chair, the invention of two professors. A child's imagination must travel far to exhaust the chair's possibilities as a toy



WHEN children use ordinary chairs, which usually are favorite playthings, for trains, ladders, or beds, their fun often ends in grief. Household furniture is scratched and broken too easily.

Two university professors, F. W. Hart, of Berkeley, Calif., and Prof. Patty Smith

Hill, of New York City, put their ideas together and invented a play chair that children cannot break, or, rather, one that can be broken easily without harming it. Children can take the chairs apart and make them into other playthings—carts, wheelbarrows, wagons, or trains.

The number of motor-cars manufactured in the United States in a month is more than four times as great as the number of bathtubs shipped from factories during the same period, according to statistics from bathtub and motor manufacturers.

He Does *Two Things* at a Time and Does Them *Well*



One of the miner-cabinet-maker's masterpieces—a talking-machine cabinet that he built and whittled in the attractive design shown above. J. B. Shedd is a self-instructed cabinetmaker.



On the table at the left are shown some other pieces from Mr. Shedd's jack-knife, the table itself being one of his prized achievements. Above he is holding one of his smaller pieces and demonstrating how he works with his jack-knife.

NEAR Bessemer, Ala., there are coal-mines. On the night shift in a man who tends an electric pump in the very depths of the earth. This man is J. B. Shedd, and at one time he found the nights long and wearisome. Near by his pump was a number of empty dynamite boxes; in his hand a jack-knife. One suggested the other, and that was the beginning of J. B. Shedd's whittling activities.

At first he whittled only crude shapes

from the boxes, but gradually, achieving a greater ease, his pieces of carving assumed a more finished shape. Then, instead of using merely one piece of wood, he made a box and decorated the sides and top of it.

One thing led to another and before Shedd realized it, he found himself to be a quite passable cabinetmaker with a knack at decorative whittling, and a reputation for making attractive bits of furniture.

No longer did Mr. Shedd find the nights too long in the coal-mine; sometimes they weren't long enough! Among the articles of furniture he has carved are tables, chairs, hookcases, and a talking-machine case.

Mr. Shedd says he never has had a lesson in cabinetwork or whittling. He still remains at his job tending the electric pump, and he has discredited the old proverb that it is possible to do only one thing at a time and do it well.

Handy Utilities for Town,

Automatic Safety Device Shuts Off the Gas

TO PREVENT explosions or asphyxiation from escaping gas in gas boilers or furnaces a device has been perfected that shuts off the supply of fuel when the pilot light is extinguished. It consists of a small box, C, containing a thermocouple, which is heated by the pilot light supplied by pipe B. When heated, this metal expands so that it opens the check valve A, permitting gas to flow from the main pipe to the burner.

Should the light go out for any reason, the metal contracts and the ball in the check valve falls again into its seat, closing the supply of gas to the main burner. The gas flow can be resumed only by re-lighting the pilot light. This can be done electrically from a distance simply by pressing a switch button that may be located in the most convenient place.



Burner with automatic safety attachment

Small Movie Machine Designed for Amateurs

A NEW motion-picture camera that both takes and projects motion pictures, made especially for the amateur, recently was perfected in France. The machine takes films of just half the ordi-



Blotter Attachment for Hand Is a New Aid for Writers

ONE who has to do much writing with pen and ink will find this hand blotter useful. It is held in position by elastic hands that slip over the wrist and around the little finger. Besides blotting, it provides a shield to protect paper from perspiring or soiled hands. It also protects the hand when stamping and sealing letters or when using paste or glue.

The Hardest Metal Surface

A NEW process for electroplating metals with an alloy composed chiefly of chromium, the hardest substance in existence next to diamonds, recently was announced by Dr. Colin G. Fink, professor of electrochemistry at Columbia University. The surface produced by this process is said to be harder than any other known metal surface.

Dustproof Hood Devised for Furnace Cleaners

FOR use in cleaning boilers, furnaces, and tanks, a new type of protection against dust, a hood of finely woven canvas that fits snugly over the head and shoulders and is held tightly to the body by elastic bands at the wrists and waist, recently has been invented by Tim Leonard, foreman of boiler cleaners for the United Electric Light and Power Company, New York City.

In the mask are extra large lenses that are non-fogging so that the worker can see plainly through dust as he cleans a boiler. The ordinary aluminum sponge respirator, with pneumatic cushion and outlet valve, is fixed inside the hood

inside reels are replaced by a circular case holding the projector light; and the machine is placed on a stand that holds two large metal reels. There are two lenses, as shown in the left-hand photo-

Country, and the Home



Rolling-Pin Massage for Weight Reduction

ROLLING oneself out with a rolling-pin to get rid of excessive adiposities may not appeal to one who wishes to lose weight, but if the rolling is done with the massaging device illustrated above, the process, it is said, need not be painful.

The four sections of the roller, fitted with vacuum cups, revolve over the body under very light pressure, producing the beneficial results from massage. This action is said to stimulate blood circulation and to break down fatty tissue, keeping the flesh in firm condition.

\$66,000,000 Paid for Air Holes

HE WHO buys ice-cream by the hulk instead of by weight, pays dearly for the air holes in the confection, according to facts revealed at the recent conference on weights and measures at the Department of Commerce.

A billion quarts of ice-cream are made by dealers in this country annually, it was found, but a fifth of the total amount sold is air space that is "packed" into the containers in which the ice-cream is sold. Selling the ice-cream by hulk instead of by weight, it is estimated, means that somebody pays \$66,000,000 for the air holes.

Metal Frame Supports New Concession Tent

AN INNOVATION in the construction of concession tents is embodied in the model pictured here. The framework is made of seamless brass and aluminum tubing, with joints of brass, which make for lightness and strength. The frame stretches the canvas, making it water-tight, and



The completed tent, with awnings

taking the strain off the guy ropes. So simple is the construction, that with but little practice the tent can be put up in 15 minutes.

The entire framework is collapsible, and when unfolded is held rigid by cross braces fastened with bolts. Two metal counters, one on each side, are set in the frame.

For severe weather four guys are used, and steel pins are driven through holes at each corner of the frame.



Metal frame ready for the canvas

Wrist Case Invented for Pencils and Pens

THE man who keeps his pen and pencils in a newly devised wrist case has them always at hand, the inventor says, and yet out of the way when not in use. The case fastens on the arm with two straps.

The pencils are attached to the case with small chains wound on spring reels that hold them in their compartments when not in use. Turning a lever at the top of the case projects a pencil from the holder so that it can be grasped. As it is pulled out, the chain with which it is attached unwinds from the reel. When the pencil is drawn back by the spring reel, it is locked automatically in its compartment. Three compartments are provided for the convenience of the wearer.



How case is strapped to wrist

Father Time Races Storck

DURING 1924, 2,645,000 babies were born and 1,333,000 persons died in the United States, or one death was compensated for by two births. If the number of births and deaths remains the same in 1925, as this rate seems to indicate, 10 babies will be born every two minutes and five persons will die in the same time.



Aluminum Honeycomb to Double Bees' Output

FOOLING bees with a new type of honeycomb made of aluminum is said to add greatly to profits of bee-keepers. By lessening the time needed to manufacture comb, it is said to enable the bee to double their output of honey.

The aluminum combs are painted with beeswax in its pure state and the bees go right ahead and fill them just as if the combs were a homemade article. When filled, the combs are put in a machine called a "honey extractor," which whirls the combs around and extracts the honey by centrifugal force. The combs then can be returned to the hive for the further manufacture of honey.

Button Operates Keyless Automatic Lock

A KEYLESS, automatic button lock recently devised for house doors may be installed in 10 minutes, it is claimed, using only two screws. Merely pressing a button in the center of the knob locks the door, while turning the knob automatically unlocks it. A glance at the position of the button shows whether the door is locked or unlocked.

Knobs may be had in either glass or metal. This type of lock is especially useful for the bathroom where the door must be locked frequently. A key is used only on the outside of an outside door, and here the keyhole is placed in the center of the knob, where it is easily found in the dark.

The button lock is a compression-spring, unit-type lock, which automatically adjusts itself to the thickness of door as it is being installed. The inner knob is detachable; but not the outer knob.



Pressing a button locks the door

New Ideas for the *Combination Range and Cabinet*



Bristle Filler for Brooms

You need waste very little of your broom bristles now that a new filler can be fitted into the handle of a broom when the old one wears out. A spring gives the broom flexibility so that the fiber bristles can be worn down to an inch before discarding.



To Remove Cap Jars

Now that canning days are here, good housewives are looking for the most efficient utensils. Above is shown a new jar-top remover, said by the inventor to be "different." A self-adjusting link grips and securely holds any size jar cap. It is very easy to handle and works quickly.



Hat-Hanger Fits on Clothes-Rack

POPULAR SCIENCE MONTHLY has pictured in an earlier issue a collapsible clothes-hanger, such as shown above, but without the hat-holder, which the inventor has added for use in small closets, where often no provision is made for hats. When extended, the hanger has four substantial hooks for clothes. When it is not in use, it occupies very little space.



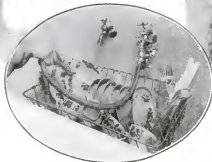
Range and Cabinet in One

Thoroughly insulated, the makers claim, so that no hot air can spoil the edibles, this combined kitchen range and cabinet is a boon to housewives, saving many steps. The cabinet forms a support for the range, and has spaces for pots and pans and kitchen cutlery, as well as drawers for spices, flour, and sugar.



Improved Meat-Grinder

With a mere shift of a lever on this improved meat-grinder, the degree of grinding from fine to coarse, or contrariwise, is changed. This little attachment makes it unnecessary to remove one cutting disk and insert another, as it has heretofore been necessary to do.



Food Grater Has a Glass Top

Said by its makers to be able to grate any kind of food, the little grater below is distinguished from other graters by its glass top, which is used for the purpose of pushing down the food and thus saves fingers from being caught.



Dishwashing Made Easy

Dirty dishes are placed in the sink rack. The hose is turned on, the soap lever pressed, dishes are sprayed with hot soapy water, then with clear water. Dishes remain in the wire rack until thoroughly dry, or remain until the next meal is set.

Up-to-Date Kitchen

Saves the Housewife Many Steps



Wooden Pot-Scraper

This scraper is for use on aluminum and glass utensils, as any kind of metal scraper is bad for them. The scraper has the advantage, too, of not setting the housewife's teeth on edge by contact of grating metal on metal.

Seven-Design Vegetable Cutter

Vegetables may be cut in seven different designs by the machine shown below, devised by a Frenchman. The slices of vegetable fits under a piston operated by a lever. Variation in shape is obtained by changing the cutting screen. Vegetables cut in this manner give a professional touch to a dinner.



Oyster-Opening Set

At right is an oyster-opening set from France. The oyster shell is placed in a cavity in the block of wood and pried open by a clawed knife, used also for detaching the oyster from its shell. The oyster then is placed in the wire rack



Safety Window-Cleaner

As shown in the picture at the right, a square cleaning pad is placed at the end of a bent rod. The operator stands on the inside of the window and passes the cleaner back and forth until the window is spotless.



Icebox like Filing Cabinet

Instead of shelves this refrigerator has closed compartments that slide in and out. This construction serves several purposes, the most important of which is that as the needed drawer is pulled out, it automatically closes the box, thus maintaining an even temperature at all times, besides being an advance over having to stoop to see what supplies every shelf contains.



Milk-Bottle Separator

There is now on the market a new kind of milk-bottle that keeps the cream separate from the milk, although, if required, the cream and the milk can be mixed by the simple means of turning the bottle upside down. It is claimed that by using the separator and pouring off the cream, a whipping cream is obtained or cream suitable for the morning coffee or for your favorite cereal.



Water Will Not Boil Over

Water will boil up and over very quickly when cooking greens. It is claimed by the inventor that by the use of the ring shown above, the greens are held down, giving more room for the water to flow and bubble, and thus preventing boiling over and saving constant watching.

Simple Camp Stove Is Heated by Blowtorch



Heated by a blowtorch, this simple little stove has room for frying and cooking, folding up when not in use

ANY make of blowtorch may be used to provide heat for this compact collapsible camp stove. Most persons have such a torch about the house or can borrow one for the week-end. The stove is simple in construction and weighs only $6\frac{1}{2}$ pounds. It has 10 burners and is 10 inches high. The supports, which fold up around each end of the stove when not in use, set firmly on the ground and hold the stove securely while the camper's coffee and bacon for breakfast are cooking just outside the flap of the tent.

Photographic Plates May Be Developed in Daylight

AFTER research extending over a period of several years, Dr. H. Leffman, a chemist of Philadelphia, discovered that the process of developing and fixing a photograph negative in the daylight, when it can be more carefully watched and controlled, is a decided advantage over the prevailing method of darkroom development.

If the exposed plate is first placed in the hyposulphite of sodium solution, it will dissolve and remove only the particles of silver bromide that have not been acted on by light. When the fixed plate is removed from the hypo solution, it is perfectly transparent, without a trace of indication that it has been exposed in the camera. Yet it keeps in latent form the picture photographed. The fixed plate or film may be exposed to daylight without injurious effect on the latent picture, which can be developed in broad daylight by submerging the photographic plate or film in a solution of chloride or bromide of mercury.

Oxygen-Generating Mask for Miners and Divers

A GAS mask that produces its own oxygen has been invented recently by H. C. Carter of Victoria, Australia. Renewing gas in masks has been for a long time a leading problem in making oxygen masks that are used by miners and divers.

Collapsible Hand-Cart Takes Little Space for Storage

ONE of the greatest problems offered to the owners of hand-carts is the amount of space they take up when stored away for the night. This new German invention seeks to overcome this difficulty. The bottom of the cart divides at the center line and the halves fold up against the sides. Then the user pulls a lever, which bends the axle and the bottom frame members, which are binged at the center, and the entire hand-cart can be pushed into a space less than two feet wide.

The picture illustrates the hand-cart in the process of being folded.



This hand-cart folds into space less than two feet wide when work is done

1000-Watt Lamps Grow Grass on Barren Lawn

IF POWERFUL electric lights strung over a barren lawn can force grass into rapid growth, why should not similar treatment make hair grow on a bald head? Tests with 1000-watt lamps at the Cambridge, Mass., Electric Light Company have shown astonishing results on grass growth.

Dr. Andreas F. Christian, of Boston, claims that bald heads may be covered, beards coaxed on clean-shaven faces, and bobbed hair grown long in a short time, by use of strong artificial light. The only requisite in cases of both lawns and heads, he says, is that the germ of life must exist.

Ears Grow Tired, Too

THE ear apparently becomes physically tired, asserts Prof. Albert Sidney Langfeld, director of the laboratory of experimental psychology at Princeton University.

By means of radio apparatus, Professor Langfeld led the sound from oscillating vacuum tubes to head phones that were adjusted until the wearer declared the sounds reached each ear with absolutely

equal volume. Then one phone was removed, and the hearer required to listen with one ear for a minute. At the end of that time both phones were used again, and invariably the subject reported hearing the sounds more loudly in the ear to which the phone had just been added.

Ceiling Insert of Steel for Concrete Buildings

BELOW is shown a recently designed steel insert that is fitted in the molds of concrete ceilings, so that when the concrete is flowed into the molds, the insert becomes firmly embedded as the mixture dries.

Thus there is established a socket that will sustain pipes or other fixtures. A threaded unit is inserted sideways through the narrow passage into the hollow square, where it is straightened out and the fixture screwed into it.



How steel insert sets in a ceiling

New York Builds the Largest Power-Generating Station

THE largest electric generating station in the world is being erected on the East River in New York City. It will have a capacity of 1,000,000 horsepower, enough to light at least 3,000,000 six-room houses. Operated at full capacity this single station would be capable of providing all of the electricity required by any state in the United States, New York excepted.

It will be capable of producing 100,000 more kilowatts than the projected power development at Muscle Shoals. Imagine all of the horses in all of the cities in the United States, 2,000,000 of them, hitched to one load. Their power would just equal that of the great aggregation of power available in New York City when the new \$50,000,000 plant is completed.

Water from the river will be used in the station and coal will be unloaded directly into hunkers from ocean-going vessels by means of traveling towers along the waterfront.

LOUD chewing is the undoing of certain insects and grubs traveling from the Orient to the United States in sacks of peanuts. A newly invented microphone intensifies the sound of their champing and enables customs officials to detect their presence. The apparatus is used, also, in finding insect pests in stored grain and fruits.

Unsinkable Rowboat May Be Folded into Compact Bundle

HERE is the latest idea in folding boats. It can be rowed or paddled like a canoe and is sufficiently large so that the passengers are not cramped. The flat bottom makes the boat steady.

Packed into a bundle as shown at the right, it weighs but 35 pounds.

Airtight chambers are arranged along both sides, so that the boat is unsinkable, even when it is full of water.



Airtight chambers set along each side of this collapsible rowboat render it unsinkable.

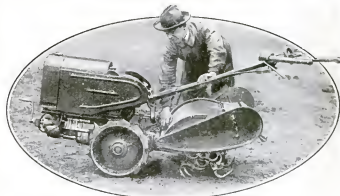
Small Pump Converts Auto into Fire-Engine

THOUGH small in size, this portable pump, which can be attached to an automobile in two minutes, will do a good day's work, raising 100 gallons of water a minute by suction alone to the pump's level and then spraying it a height of from 50 to 60 feet.

The pump is operated by means of a belt around the rear wheel of an auto after the wheel has been jacked up. It is especially recommended for small towns that have no regular fire-fighting equipment or those in the neighborhood of large forests. It also is useful for pumping out cellars and ditches after an accident or a flood has caused an overflow of water that will not drain off quickly.



Hitched by pulley to the hind wheel of an auto, this small pump is said to raise 100 gallons of water a minute.



New Gasoline Tiller Replaces Old "Dobbin"

THIS remarkable invention consists of a one-cylinder gasoline engine built into a compact one-man machine arranged to do tilling and ridging in one operation.

It is claimed that this compact little machine will prepare two acres of land in an ordinary farm day. One of its most important features is that it is so small it can be used under overhanging branches and between growing bushes where no ordinary type of plow could be used, and this is especially useful in orchards where land between the trees is utilized for growing vegetables.

An Amazing New Auto

FROM Poland recently came word of an astonishing sort of automobile. It is the invention of an engineer named Kerpowski, and he calls it the "Polonia," after his native land. It is designed to bring about the utmost simplicity and speed in making repairs and replacements of parts.

In a recent public test, two mechanics and a helper took down the motor, gear set, universal, and rear axle in 14 minutes, and had the car completely reassembled in

36 minutes additional. The car has a six-cylinder motor, develops 45 horsepower and is said to be capable of a speed of more than a mile a minute.

Mouse- or Rat-Trap Is Set by Pressure of the Foot

NO ONE wants to set a mouse-trap. The little wire is fixed just right, when "Snap!"—once again your fingers are caught.

In the illustration at right is shown a new safety mouse- and rat-trap, which is set with pressure of the foot. After a rodent is caught and killed, a slight pressure on the footplate will release it. The trap is made of galvanized steel and wire.



Pressure of foot will set this novel mouse-trap.

For Farm and Garden



Handy Grass Trimmer

Operating like a barber's clipper, the handy little grass-trimmer shown above is designed to cut the uneven edges of lawns and to penetrate corners no ordinary lawnmower could negotiate

Some Ingenious Outdoor Ideas That Will Be Found Useful



Kansas Breezes Grind Farmer's Corn

No sluggards in Kansas! Even the wind does double duty. Beside drawing water, it grinds feed for the stock of E. K. Edwards, who built the ingenious windmill shown above, thus saving one man's labor daily



Butter Churned by Bicycle-Power

This ingenious apparatus for churning butter was rigged up by a Minnesota farmer. Raising the rear of his bicycle on wooden stilts, he ran a belt from the rear wheel to the wheel drive of the odd churn

"Rain-Making" Tower

William Haight, of Wilmington Park, Calif., claims he can make rain by the manipulation of what he calls negative electric ground waves and positive waves of the atmosphere's upper strata. His apparatus, mounted on a tower (at extreme left), is designed, he says, to reverse the natural order of electrical emanations, resulting in a pulsating current between the ground and upper strata, which in turn causes condensation of cloud moisture and brings on rain. Mr. Haight is pictured at the left



For Rough Mowing

At the right is a new mowing machine designed to "top" tall growth or to clean up a lawn after a lawnmower. It is not intended to replace the lawnmower. It is said to cut 10 times as fast as a scythe



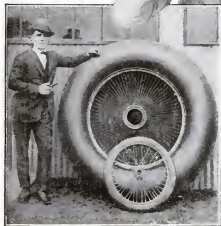
They Don't Come *Any* Bigger

These Oddities Claim the World's Records for Size



Padlock for Park

This immense golden padlock and key were used in the recent celebration officially opening the Zion National Park, in Utah



Supports 10 Tons

The largest pneumatic tire ever made in America—54 by 14 inches—was designed for the landing gear of one of Uncle Sam's largest planes. It will carry 20,000 pounds

A Long Smoke

A briar pipe 5½ feet long is Lady Nicotine's latest curiosity. It requires the services of a smoker and two assistants to get it really going



A 22-Foot Saxophone

Wanted—a musician with lung power enough to play the world's largest saxophone that forms part of an advertising display for a New York musical-instrument concern. This giant jazz creator is 22 feet high and its bell is four feet in diameter. Workmen are seen hoisting it into place



Have a Match?

Have you ever seen larger matches than these? Dixie Boatwright, popular Ziegfeld Follies girl, who is seen carrying a box of them on one shoulder like a bundle of kindling wood, says you don't strike them any bigger hereabout



Puzzle—Find the Man

Barney Winters, of New York, boasts of a hat that would fit a giant—all straw and a yard wide at the brim



By the use of heater lunch-box, food is served appreciably

Carry Your Own Hot-Lunch Kit

A UNIQUE little "traveling restaurant," invented in France, enables you to have piping hot food instead of cold lunches at work or on picnics. It is a portable box about the size of a brief-case, easily carried on hikes or in motor-cars. In one section are ohlong plates supported in a frame raised slightly above the side of the case.

Small gasoline or alcohol cube lamps under these heat the food at lunch-time. Leakproof metal lids fit over the compartments.

A plate, knife, and fork are held in the other side of the valise and a thermos bottle and drinking-cup are placed in special racks. The open box forms a small table as it rests on the user's knee, as shown.



Ingenious Column Ruler Saves Time in a Busy Office

THIS time-saving appliance for ruling columns consists of a grooved brass roller set in a handle. It is provided with an absorbent swath that fits into the slot and feeds the roller with a supply of special red ink.

The device is made in three sizes, for ruling one, two, or three columns, and is a great time-saver.

Grass Causes Hay-Fever

DEVIL-GRASS, the curse of lawns in California, is the chief offender in causing hay-fever in that state, according to Dr. George Piness of Los Angeles, who has been carrying on extensive research to find out what caused the trouble. California does not have the ragweed that causes much suffering among hay-fever victims in the East, but a large number of persons are sensitive to the pollen of Bermuda grass or devil-grass.

Climbs Steel Girders with Patent Grippers



ABOVE is John E. Seaberg of Pittsburgh, Pa., demonstrating a simple but clever device he has just invented to aid structural ironworkers in climbing steel girders. His invention is a pair of wooden clogs equipped with steel grippers

that engage the projecting edges of the girder, making it possible to climb as easily as if he were walking up a telegraph pole with its iron spikes. This invention, Mr. Seaberg says, saves much time.

IF YOU have a gallstone, you pay to get rid of it, but there are people in the world who will pay as much as \$50 for a good one. Chinese and Japanese are said to hang the stones about their necks to ward off disease and bad luck. A packing plant in Omaha, Neb., collects the gallstones found in slaughtered steers and sends them to the Orient.

Heart-Shaped Glasses Protect Eyes of Movie Actors

IT IS a well known fact that moving-picture actors who have made a number of "inside" pictures frequently are troubled by what is known as "studio eyes." The condition is caused by long exposure to the intense rays of the cluster lights, and frequently an actor has had to take a protracted rest to recover from such an attack. The picture below shows Claire Windsor, famous movie star, wearing the latest thing in "studio glasses," heart-shaped to relieve their otherwise ugly appearance on the wearer. These glasses are made in diamond, square, or spade shape. The lenses are smoked to rest the wearer's eyes as much as possible.



Heart-shaped smoked glasses protect tired eyes

Know Your Car

REMARKABLE as it may seem, sometimes the best way to make your car ride easily is to avoid oiling the springs. This applies particularly in sections where the roads are full of "thank-you-mamas" or successive depressions and bumps so spaced that the car acquires a forward and backward pitching motion. On such roads, an auto with well oiled springs will pitch so badly that the driver's neck will become tired due to the constant swaying.

It was once thought that failure to oil the springs caused the breakage of the spring leaves, but engineers now claim that a dry spring may be expected to last as long as a well oiled one.

Remember these rules if you want the maximum comfort in driving over rough roads:

- 1—Pump your tires only to the lowest pressure recommended for the size of tire and the weight you are carrying.
- 2—Fit good shock absorbers that actually apply friction during the recoil of the spring.
- 3—Keep your springs thoroughly oiled if the car is fitted with shock absorbers.
- 4—Auxiliary springs will be a help on rough surfaces.
- 5—Slow down or speed up if the car starts pitching violently so as to get the speed of the car out of tune with the humps.

New Process Makes Golf Clubs Waterproof and Hard

A NEW process for treating wooden golf clubs makes them waterproof and extremely hard. Heads of seasoned persimmon wood are subjected to a vacuum that extracts every particle of air and moisture from the wood, which then is impregnated with the newly discovered chemical. The club heads then are dried and hardened.

Clubs treated in this manner are said to have greater driving power than other wooden clubs and not to shrink or expand with varying atmospheric conditions. Inserted face plates are not required, since the chemically treated wood is itself harder than fiber, bone, or ivory.



Pen with Three Points Aids Bookkeepers in Ruling

THE tedious work of ruling ledgers and cash books in the small office is much simplified by an ingeniously made pen having a broad nib divided into three points like a fork.

Two of the extra penpoints are quite close together, making the double line for the extreme left-hand column in a ledger.

In a single stroke a whole cash column can be ruled. New nibs can be bought for the pen when the old ones are worn.

Newest Home Trousers Press

THERE have been innumerable trousers presses on the market from time to time, but the maker of the model illustrated at the right claims that his is the simplest of them all. It has no top board and not a single nut or screw goes into its construction. Pressing and stretching are accomplished in one operation. The curved shape of the board is said to insure enough gentle stretching to eliminate hugginess at the knees. Sufficient pressure is obtained with one hand.

WOMEN with dark hair are better automobile drivers than blondes, according to P. L. Emerson, owner of a large taxicab company in Chicago. He related this in conjunction with a statement made by psychologists, who found brunettes more conservative, on the whole, than fair-haired persons.



One-Piece Tennis Suit Gives a Longer Reach

PERHAPS it was the comfort of his swimming-suit or coveralls that inspired Mr. P. Mundet, a Frenchman, to invent a similar type of suit for playing tennis. It is in one piece and all except color and length of sleeves resembles a cover-all.

When making long reaches or twisting for a back stroke, a belt about the waist is noticeably restrictive, while a loose, one-piece tennis suit, opening down the middle front, brings comfort, it is claimed, as well as more ease in playing.

Years Ahead in Knowledge

I THINK the magazine wonderful and do not see how a family with growing children could do without it. It puts people who read it years ahead of people who do not.—C. W. C., Franklin, Pa.

Smoking-Tube Is Latest Fad for Fastidious Women

IT'S a headlight when the cigarette is lighted. A vacuum cup holds the cigarette firmly to the rim of the smoker's hat, so that she can smoke with ease and comfort.

The holder with rubber tube can be adapted for use while reading in bed, riding in an automobile, or playing cards.



Smoking a cigarette by long distance



One-piece tennis suit is comfortable

Scientist Says Meat-Eaters Live Longer than Vegetarians

VEGETARIANS received a blow when Prof. James R. Slonaker, a Leland Stanford University physiologist, declared recently that meat-eaters live just as long as their abstaining brothers, in fact, longer. For eight years he has been experimenting with meat and vegetable diets on rats and now is applying his results to human beings.

When the rats were fed vegetables only, the span of their lives, he found, was shortened, in males 33 per cent; in females, 40 per cent. Males lost 35 per cent weight, and females from 25 to 28 per cent. By the third generation the non-meat-eaters lost the power of reproduction, indicating that vegetables lack something necessary to health.

THE greatest underground electric power cable ever installed is to be put in New York City to protect the city in fire-fighting. It will be operated at 132,000 volts and will link together the generative stations of the New York Edison Company with its subsidiaries, reducing the possibility of interruption to the Fire Department's pumping during a fire.

How Much Do YOU Know about Science?

THE following questions, dealing with the common facts of science, are the kind that POPULAR SCIENCE MONTHLY receives daily. Look them over and see how many of them you can answer.

Don't let your brain get lazy. Give it the sort of stimulant that these questions offer, and you will find your faculties sharpened and your appreciation of the world's natural wonders greatly enlarged. Now turn to page 135 and see what percentage of the 12 questions you were able to answer correctly.

1. Why do liquids rise in a straw through which you drink?
2. Why do the men near the guns on a battleship open their mouths when the guns are fired?
3. What is invisible ink?
4. How far does the earth move each day in its journey around the sun?
5. Where does the sand on the seashore come from?
6. What are sun-spots?
7. Why does hydrogen peroxide bleach the hair?
8. Why is there no air inside an electric-lamp bulb?
9. How does a whale keep warm?
10. Why must a vacuum-tube filament be hot?
11. What is the tallest tree?
12. Why does your face get white when you are frightened?

What Batteries Are Best for Your Radio Set?

How to Save Money and Trouble by Making the Right Choice

ALL radio receivers except crystal sets require a supply of electric current to operate them. And if we are to get the kind of radio reception we want, the sources from which we draw current for our radio sets must be capable of delivering electrical energy in a steady, uniform flow for hours at a time without appreciable change in voltage.

Furthermore, we need two, and in some cases three, different sources of current supply. The filaments of the tubes must be heated, electrical pressure must be applied to the plates of the tubes, and in circuits where it is needed we also must use a third source of energy to keep the grids of the tubes at the proper potential.

Coupled with our desire to secure perfect reception is the need for obtaining satisfactory results at the lowest possible cost and at a minimum of trouble. And it is this matter of trouble and expense that sometimes makes the problem of current supply a decidedly vexing one. Obviously, it does not bother the man who can afford to go to his dealer and arrange with him to see that the radio set always is operating properly, regardless of expense.

For the beginner the question is complicated still further by the fact that there are three types of vacuum tubes in common use today, and each type requires different pressure and volume of current to heat the filament.

IT SEEMS logical to decide on the type of tube first, and then to study the various ways in which current may be supplied to the filament circuit.

Most people have found that, all other conditions being equal, the tubes that use one-quarter ampere apiece at a pressure of five volts will give greater volume than the tubes ordinarily sold for operation with dry cells. In addition, the larger tubes seem to run more uniform in characteristics.

There is little choice between the two types of dry-cell tubes on the score of operating results, although there is a slight difference in economy. Three dry cells in series are required to operate the .06-ampere dry-cell tube as against one dry cell for the one-quarter-ampere tube. However, the three dry cells last more than three times as long as the single cell used on the other tube.

The mere fact that a certain type of tube is called a "storage-battery tube" and that another type is called a "dry-

By John Carr

cell tube," does not mean that the filaments of the tubes necessarily must be heated with current from any particular kind of battery. Storage-battery tubes can be operated from dry cells, and vice versa. It is merely a question of selecting the source of current that will prove most economical of your time and money in your own particular case.

Take, for instance, the typical case of a superheterodyne receiver built for use

B current would result in marked economy of operation. On the other hand, the owner of the receiver might figure that the additional care and attention required by the storage batteries would more than offset the saving in money.

You can see, therefore, that the personal equation enters into the problem and is usually the deciding factor.

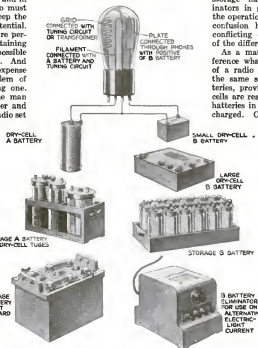
AMONG beginners particularly, there seems to be considerable confusion about the relative merits of dry cells, storage batteries, and B-battery eliminators in giving satisfactory results in the operation of the radio receiver. This confusion has been caused mainly by conflicting claims of the manufacturers of the different sources of current supply.

As a matter of fact, there is no difference whatever between the operation of a radio receiver using dry cells and the same set supplied by storage batteries, provided, of course, that the dry cells are reasonably new and the storage batteries in good condition and properly charged. Old dry cells that are nearly exhausted sometimes will produce a lot of noises that sound like static. Storage batteries also offend in this respect if the connections become corroded.

If you are troubled with noises in your receiver, however, merely buying new batteries or another type of battery is not necessarily a cure-all. A defective tube or a bad connection in your receiver may be entirely responsible, or the noise may not originate in your equipment at all. Some piece of electrical machinery near by may be radiating energy that affects your receiver like static.

A STORAGE battery requires recharging at regular intervals, depending on how much you use your receiver. At least once a month the level of the solution in the battery should be inspected and distilled water added. This applies to both storage-A and storage-B batteries of either lead or alkaline type.

If electric-light current is available in your home, recharging the storage battery is simple. A variety of chargers are on the market. Some use tubes, others rectify electrolytically, while still others are of the vibrating reed type. The Popular Science Institute of Standards has tested and approved a number of these devices, and any of the approved



The Sources of Current Supply

At the left are the A batteries, ranging from the single dry-cell to the standard six-volt storage battery. At the right are the various types of B batteries and B-battery eliminators in common use. The small dry-cell B battery at the top of the column is useful for portable sets, but is not economical for regular use

with dry-cell tubes. Assume that several members of the family use it almost daily, so that the total number of hours of operation a month may be well above the century mark. Under such conditions it is easy enough to prove that a set of storage batteries to supply both A and

types will give you excellent service.

Some of the approved chargers are so arranged that they are capable of recharging either A or B batteries with the same apparatus. Others are made specially for A batteries or for B batteries.

Storage A batteries are made in a number of sizes and the beginner often is unable to decide which size will be best for his own use. The answer all depends on how many tubes are in your set and how many hours a week you expect to use it on an average. If you have your charger wired up to switches so that putting the battery on charge is merely a matter of throwing a switch, it makes little difference whether you have to charge the battery every week or only once every two or three weeks.

GENERALLY speaking, it is advisable to get a battery large enough so that you can charge it regularly once a week—say every Saturday night after you are through listening in. For a small set using not more than three tubes, a 40- or 60-ampere-hour battery is sufficiently large. For a five- to eight-tube outfit an 80- to 100-ampere-hour battery is ample. Remember that an eight-tube outfit using one-quarter-ampere tubes draws only a total of two amperes, and this amount of current will not prove an injuriously rapid discharge rate for even a 40-ampere-hour battery.

Storage-battery operation of the tubes in any receiver designed for use with the dry-cell tubes is practical also for the man who does not mind the additional trouble of taking care of the battery. For 1½-volt outfits that are arranged to operate on a number of dry cells connected in parallel, a single-cell storage battery is used, while a two-cell storage battery is used for the tubes that require three dry cells connected in series.

THE advantages of a storage-battery source of supply for your B current also depend on the number of tubes you are using. A one- or two-tube outfit uses so little current that the large dry-cell B batteries often last for more than a year, and there is certainly no possible advantage in a storage B battery under these conditions. With multi-tube sets, however, it is another story. If you have a five-tube receiver or a "superhet," and use it considerably, the storage B battery will prove an economy, provided you are willing to give it the care and recharging it requires.

In such a case it is easy to make a direct comparison of the actual expense of supplying B-battery current to your set if you will assume some definite number of hours a day as representing the amount of time the set is in use. Three hours a day should be a fair average. Of course, there will be a number of days when the

radio set is not used, but, on the other hand, the set will be run all afternoon by one member of the family and until the wee small hours by the owner.

We also have to assume that the set consumes a definite amount of current—say 25 milliamperes. This is more than some five-tube receivers use, and less than most of the "superhets."

Under such conditions, an extra large

Before deciding on whether storage B batteries are a worth-while investment for you, be sure to study Mr. Senauke's article on page 72 of this issue, explaining the important part the C battery plays in cutting down the amount of current drawn from the B battery.

Of the B-battery eliminators on the market today, some are excellent; others do not give results comparable with batteries.

The B-battery eliminator should be considered on dollars-and-cents basis as a source of current supply. Any claim that a B-battery eliminator will give you better reception than is possible with batteries obviously is absurd. Good batteries will give you a perfect source of current supply, and all that any B-battery eliminator can hope to do is to equal the results obtainable with batteries.

THE advantages of a good B-battery eliminator are apparent. Once installed it will last indefinitely and will require no attention except the occasional addition of distilled water to the electrolytic tubes and the renewal of tubes in the models that use tubes to rectify the alternating current. This matter of tubes for use in B-battery eliminators is still causing some trouble because the ordinary radio

tube does not have a sufficient current-carrying capacity to operate some of the larger receivers. Special tubes adapted to this particular use already are appearing, and these new tubes, of course, can be used in any of the standard B eliminators.

A B-battery eliminator will not work properly always on every type of circuit and under every condition. If you decide to buy the B-battery eliminator, be sure to have your dealer demonstrate it with the set you intend to use.

Cloth from String Beans

A PROCESS for making coarse cloth from the fibers of string beans was perfected recently for commercial use in Austria. The bean shells are treated like hemp, and the fiber that results can be spun, making a hard but strong yarn.

This new material is expected to offer competition to hempen products. It is adaptable for making materials for which cotton has been used heretofore, and it can be used in making carpets, curtains, upholstery, and saddlery after it has been bleached properly and printed.

Milky Water Appears in Norway

PERSONS living on the shores of Sognefjord, the longest fjord in Norway, were startled greatly by a strange phenomenon. The water, which is usually dark and clear, suddenly became milky and opaque. All of the fish in the water disappeared. No explanation has been found so far for this weird occurrence.

Builds B Battery from Old Ink-Bottles



INTERESTING experiments can be performed in the home construction of storage B batteries. It is possible to build a battery out of old ink-bottles and pieces of lead wire with a solution of sulphuric acid and water. The illustration shows such a battery built by John A. Clark, head of the Physics Department of Alexander Hamilton High School, New York, for use in his class demonstrations. Such a battery will produce a voltage of two volts a cell, but the home constructor usually finds to his dismay that the capacity of the battery he has built is so small that it will run the radio receiver for only a few minutes before it is discharged completely.

B battery of the dry-cell type, consisting of two of the 45-volt heavy-duty blocks, will last for about a third of a year. Such a battery will cost in the neighborhood of seven dollars, or a total expense for the year of \$21 for B-battery current.

A suitable storage battery for such service will cost around \$40 and will last five years or even longer if exceptionally well cared for. This amounts to about eight dollars a year, and to this expense must be added the cost of recharging, which figures out at approximately \$2.50 if you assume that the battery will need a 10-hour charge at least once in every two weeks to keep it in good condition and you have a reasonably efficient A-battery charger that can be used also to recharge the B battery.

TWO types of storage B batteries are in general use today—the acid type and the alkaline type. It is claimed for the latter that they will stand more abuse in the way of allowing them to stand discharged, or too rapid charging. While this is true, the lead-acid type maintains its voltage practically unchanged until nearly discharged. Another claimed advantage of the alkaline type is that since it contains no acid it cannot damage the rugs if, perchance, any of the solution is spilled. This claim seems to be unfounded, for the caustic potash it uses will chew holes in a rug just about as quickly as the sulphuric acid in the lead type. Neither type will give you any trouble in this respect if ordinary precautions are taken.

When Is a C Battery Worth While?

Remarkable Tests Reveal New Facts about Quality

THERE are, probably, thousands of perfectly good C batteries now resting unused in an equal number of homes where radio sets are installed. The owners of these batteries thought them after reading somewhere that there would be a wonderful increase in volume and quality of their reception merely by the addition of a C battery to the circuit. And then, when the promised advantages did not show up in loudspeaker results, the disgusted radio fans characterized what they had read as humbug and discarded the C batteries.

The trouble is, of course, that the real advantages of a C battery do not always show up in the loudspeaker. For that reason, the Popular Science Institute of Standards has just completed a series of experiments designed to show just when and how the use of a C battery benefits the radio fan.

We studied the use of a C battery in an audio-amplifier circuit from three standpoints: First, to find out what effect, if any, the C battery has on quality of reproduction without regard to volume; second, what the C battery does to the volume and, lastly, what value a C battery has in increasing the life of the B battery by cutting down the amount of current used in the plate or B circuit.

An amazing fact developed from our tests was that the value of a C battery in a circuit depends largely on the quality of audio transformers used. In our test we used two types of audio transformers. One was a low priced, low quality make, and the other was a high priced type considered one of the best.

The transformers were connected to couple two storage-battery-type amplifier tubes of standard make in the conventional audio-amplifier circuit. The voltage amplification for one stage, including the transformer and one tube, was measured through the range of from 150 to 3000 cycles with a normal signal, first without the C battery and

By Alexander Senauke, M.E., E.E.

Radio Engineer,
Popular Science Institute of Standards

then with one connected in the circuit.

The results of these tests have been plotted in graphic curves as shown at foot of the page. The ideal curve for an audio-frequency transformer really should not be a curve at all. It should be a straight line. No transformer is absolutely perfect, so that the quality of a transformer as an audio amplifier can be determined by noting how much the

tendency to damp out these frequencies.

As far as volume is concerned, the C battery helps much more with a high grade transformer than it does with a low grade one. This is especially true if two stages of amplification are used where the cumulative effects of irregularities in the amplification curve are magnified greatly.

From the standpoint of economy of current in the B circuit, the use of a C battery always is desirable. A standard type of storage-battery vacuum tube used in the conventional audio-amplifier circuit with 90 volts of B battery draws about four milliamperes. When a C

battery is introduced in the circuit, this current flow from the B battery is cut down to about 1½ milliamperes, so that in the five-tube receiver employing two stages of audio amplification there will be a saving of five milliamperes in B-battery current.

This amount of current saved may be as much as from 25 to 30 per cent of the total current drawn from the B battery and may prolong their life as much as 60 or 70 per cent. When storage B batteries are used, the saving in current is relatively unimportant because storage B batteries must be recharged every so often.

To sum up, our tests show that the C battery is always worth while from the standpoint of economy and that the volume always is increased, at least to some extent. This increase in signal strength is obtained without any falling off in quality except when low grade audio transformers are used, in which case the quality actually may be poorer with the C battery than without it.

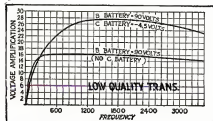
THESE tests were made on a signal of normal strength that did not overload the vacuum tube. When a strong signal is being received, the C battery has another advantage. By negatively biasing the grid, the plate-current variations are kept below saturation point of the tube. The C battery, therefore, helps you get volume with the minimum distortion.



Testing Plate Current
Mr. Senauke recording the difference in the total plate-current of a receiver when used with and without a C battery

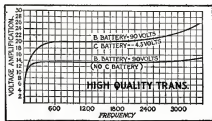
amplification curve deviates from a straight line. From the results of our tests it appears that a cheap, poor quality audio transformer actually may give better reproduction of voice or music when used without any C battery, providing, of course, that the signal strength is low enough so that the tube is not overloaded. The diagram at the left shows this.

Now look at the right-hand diagram, and you will see what happens where a high grade audio amplifier is used. In this case the quality is just as good with the C battery as without it; in fact, the slight increase in amplification at the higher frequencies may actually improve the quality of the music from many types of loudspeakers that have a



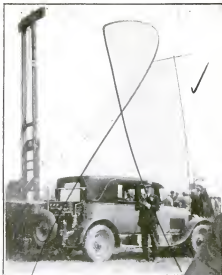
How C Battery Affects Quality

The curves at the left show how the use of a C battery may actually degrade the quality when used with a poor audio transformer. With a high class transformer the volume is increased without affecting quality (shown at right)



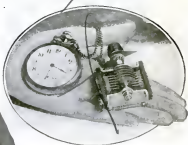
Radio Sparks

*Flashes of Progress Made
by Fan and Manufacturer*



Horse Races Broadcast

A remarkable portable broadening station built into a standard automobile was used recently to broadcast the horse races at Belmont Park, N. Y. The short-wave signals from the portable station were picked up by station WBOQ and re-broadcast on regular wave lengths

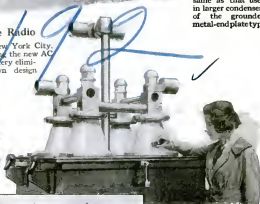


A New Midget

Unusually small midget variable condensers now are available to the radio fan for Vernier tuning. Very small variable condensers of this type also are useful as balancing condensers. The construction is the same as that used in larger condensers of the grounded metal-endplate type

Builds Unique Radio

Rutledge Mayo, of New York City, has built a receiver using the new AC tubes and a B-battery eliminator of his own design

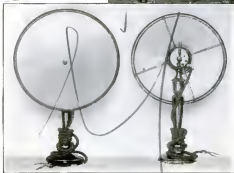


Radio Calls Police

The New York Police Department is trying out a wonderful new device that makes it possible to flash signals to all the police stations direct from headquarters. A light flashing up at the receiving set warns that a message is about to be transmitted

Homemade Loudspeaker

The novel cone-type loudspeaker at the right was made from a candlestick holder, an old-fashioned lamp-shade, a paper cone, and a loudspeaker unit. A piece of bus wire was fastened between the center of the diaphragm and the center of the paper cone



Huge Condenser

The fixed condenser illustrated above now is being installed by an American firm at Rugby, England, for use with the transmitter of the powerful radio station at that point. The tremendous size of this monster condenser can be judged by comparing it with the small radio condenser in the girl's hand. Every detail of the installation of such a condenser must be done most carefully



This view of the wave trap shows how the upper coil B is connected with the variable condenser. Notice that ample space is provided for additional turns on the lower coil A, if needed.

How to Build and Use A Simple Wave Trap To Stop Radio Interference

By Alfred P. Lane

with a composition panel and a wooden base board in the conventional manner, but you can take almost any liberties you like with the arrangement so long as you are careful to keep the variable condenser or any other metal part away from the open ends of the coil.

After you have mounted the complete coil, the variable condenser, and two binding posts, the wiring will take only a few minutes. Connect the ends of coil A with the two binding posts and then connect one end of coil B with the binding post on the variable condenser that is connected with the rotary plates of the condenser. The other end of coil B goes to the binding post on the variable condenser that is connected with the stationary plates.

The two ways in which the wave trap can be connected with your receiver are shown in the diagram. The best way can be found only by experiment.

In many cases the radio fan is troubled

THE only trouble with a wave trap or interference eliminator, as it is sometimes called, is that most radio fans expect such a device to perform miracles. And then, when the results are not as expected, the device is promptly relegated to the scrap pile, even if the failure of the wave trap really is due to an incorrect hook-up.

Properly used, a well made wave trap often will help a great deal in eliminating interference from local stations. But you must be prepared, in building the wave trap described here, to experiment a bit until you get it working correctly with your own radio receiver and under your own particular conditions.

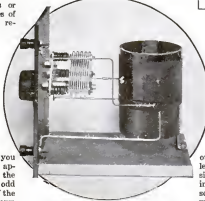
This wave trap, which has been tested and approved by the Popular Science Institute of Standards, can be adapted for use with any type of radio receiver that operates on an outdoor antenna. The circuit used in the receiver has considerable effect on the wave trap. A single-circuit receiver, for instance, requires that the trap be used in the series connection. On the other hand, a wave trap can be used either in series or parallel with the more selective types of receivers such as the three-circuit regenerative, neutrodyne, and so forth.

Whether the series or parallel connection will be best in any particular case can be determined only by experiment. It depends on a number of factors such as the natural selectivity of the receiver, the length of the antenna, and the power and broadness of the interfering wave.

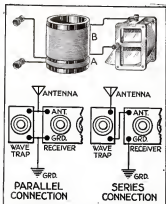
The actual construction of the wave trap is very easy. First study the picture wiring diagram on this page. You will note that you have to purchase only one piece of apparatus, the variable condenser, and the chances are that you will have an odd condenser tucked away in a corner of the workbench that will serve nicely. As shown in the illustrations, the wave trap was built

The capacity of the variable condenser is also relatively unimportant. You can use a 13-plate, 17-plate or 23-plate type. Of course, you must wind the number of turns in coil B that will enable you to tune the wave trap to the wave of the interfering station. If you use a coil form three inches in diameter and No. 22 double silk-covered wire, wind about 70 turns of wire for coil B if used with a 13-plate condenser. Sixty turns will be about right for a 17-plate condenser, and 50 turns if you use the 23-plate type.

You will have to wind coil A to suit the particular conditions under which you use the wave trap. The model shown here has nine turns of wire spaced one-quarter inch from coil B. It is best, since the number of turns in coil A may have to be changed, to wind on more turns than specified. It is a relatively simple matter to take off turns from any coil, but if you find it necessary to add turns, the only really good way is to rewind the whole coil in order to avoid unsightly soldered joints in the wire.



Another view, showing how lower coil A is connected with the panel binding posts.



Above: Pictorial wiring diagram, showing hook-up of the wave trap. Below: Two ways of connecting wave trap with receiving set.

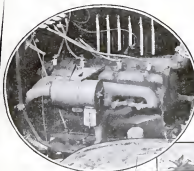
with interference from one particular station that is so near and so powerful that it even may interfere with the reception of other local stations operating on wave lengths 20 meters or more higher or lower than that used by the station from which reception is desired.

When the wave trap is used in the series connection shown above, it is tuned to the wave of the station to be eliminated and all other stations on higher and lower wave lengths still can be received, although the signal strength of the stations nearest the interfering station will be cut down to some extent. Thus the series arrangement is best for use when one station is

(Continued on page 124)

Newest Auto Improvements

Accessories that Add to the Motorist's Comfort



Easily Attached Air Cleaner

Above: Air enters at the rear and is whirled around by vanes. Dirt is thrown outside of the air column by centrifugal force and collects in the detachable box, held by a wire.

Automatic Tire Rack

A large spring is concealed in the hollow tube that forms the support of the tire rack illustrated at right. This spring balances the weight of a heavy tire so that a driver can exchange spare and punctured tires without effort.



Filler Gage for Ford

Below: This new gage takes the place of the regular filler cap on the gas tank and makes refilling the tank a simple matter without removing the cap.



Rubber Bands Steady Car

At right is shown a simple device for cutting down the excessive springing of a car.



Pedal Extension

Owners wearing wide shoes have difficulty in working the reverse pedal without interfering with the other pedals. This device solves the problem simply, as shown.



The Tricks in Shifting Gears

Gus, the Expert Mechanic, Gives Some Sound Advice to the Beginner Who Comes to Grief on a Hill

By Martin Bunn

GUS WILSON, half owner and chief mechanic of the Model Garage, always claimed that he could tell by the sound of the telephone bell when the party at the other end of the wire was in serious difficulties. It was not strange, then, that he chuckled a wrench back into the toolkit and stood up with a yard-long screw on his face as the telephone rang sharply and insistently. The ringing stopped abruptly, and a few seconds later Joe Clark, his partner, popped out of the office where he kept track of customers' accounts and said the hook-keeping.

"Ding bust it!" exploded Joe. "Al Taylor from Ridge Street has got himself all mused up down at the bottom of Smoke Hill and he wants to be hauled in right away. Can we make it?"

"Make it?" said Gus, disgustedly. "Sure we can. But how about this job for Mrs. Jenkins? You know we promised it this morning. Can you lay off those hills long enough to—"

"Sure," grinned Joe. "That's where I shine as a mechanic—finishing up jobs when all hard work is done."

GUS answered with an unintelligible grunt, cranked up the wrecking truck, and rattled out of the garage with the mudguards flapping like the wings of a bedraggled and much frightened chicken. The wrecking truck was built for service, not for looks.

Smoke Hill, about three miles south of town, was commonly spoken of by motorists as a "cork-puller." A sharp turn at the bottom prevented any chance of rushing the grade, which was mild enough for the first hundred yards. And the ease with which this part of the hill could be negotiated proved the undoing of the inexperienced motorist, for it became gradually steeper and steeper until, near the top, the grade was so stiff that few cars could make it without changing to second or even first.

Gus found Taylor about halfway up the hill. His car was off the road and the smashed mudguard and broken rear wheel jammed against a large oak tree testified mutely to the cause of the accident.

The unlucky motorist rushed over to the truck as Gus applied the brakes and began volubly and excitedly to explain just how it happened.

"No need to go into details, Mr. Taylor. I can see how you got into trouble," inter-

rupted Gus. "This is where you would have to shift into second. I suppose you got rattled and couldn't get the gearshift to work—and while you were fussing with it, the car started rolling backward—and here you are!"

Taylor appeared surprised and a bit crestfallen.

"Then it was my fault? Gosh, I thought something had gone wrong with the transmission, and I was so rattled I never thought to put on the brake until it was

"Tell me, Gus, what did I do wrong?" Taylor asked as they drove carefully down the hill in the direction of town.

"Well—no offense meant, Mr. Taylor—but you are a new driver, and almost everything a new driver does is wrong. The thing you did is one that often trips up the man who hasn't had a whole lot of experience."

"Go on," said Taylor, "you can't hurt my feelings. I thought I was the real thing as a driver. Now I know I'm not; so go right ahead, and maybe next time I won't be so dumb."

"You see, Mr. Taylor, gear-shifting is mostly a matter of practice and knowing what happens inside the transmission case when you work the lever," said Gus. "Also cars are just like horses. You must be wise to the particular whims of the critter you happen to be driving because no two are exactly alike. That's why a man who can handle one car in fine style often makes noises like a beginner when he is driving another make."

"HUH," said Taylor, a bit peevishly. "Nobody can say that I can't shift gears quietly! I snap 'em in before they get a chance to grate!"

"Sure," Gus went on; "and that is just where you make your big mistake. You 'snap 'em in,' as you say, without any regard for the relative speeds of the gears you are trying to get into mesh, and everything goes fine and dandy until you get caught because the difference in speed is too much. Then they simply refuse to snap in, and you end up by -ying to push over a two-foot tree. You ought to be thankful the tree was there to stop you. You might have had a doctor's bill to pay in the bargain!"

Taylor shivered involuntarily.

"That's a pleasant thought," he said, more humbly. "Go on—I haven't any right to be proud."

Gus said nothing for a few seconds, for they were approaching a crossing and the wrecking truck with its trailing load claimed his undivided attention.

"Look at that fellow there who is waiting for the trolley," he exclaimed suddenly. "Watch him when he tries to jump on. See, he stood still and the trolley nearly pulled his arm out by the roots."

"There's a good example of what hap-



GUS says—

1. Always take your foot off the accelerator while you are shifting from first to second or from second to third speeds.
2. Keep your foot on the accelerator when you shift to a lower gear on a hill.
3. Avoid speeding up the car in first—shift to second before the car has gone more than 10 feet.
4. After shifting from first to second or from second to third, be sure that you do not press the accelerator again until the clutch is fully engaged.
5. Never try to shift into reverse gear when the car is traveling forward. Wait till it stops completely.
6. Make sure that the transmission case is filled to the proper level with exactly the kind of lubricant specified by the maker of the car.

too late. Now I suppose I'll have a nice, fat repair bill," he added ruefully.

Gus hauled the truck into position to hoist the rear end of the car preparatory to towing it.

In a few minutes the two men had everything shipshape, and when Gus cranked the winch, the rear end of the damaged car left the ground on a perfectly even keel.

pens when you try to shift gears by snapping them in. If the speeds of the two gears are somewhere near alike, they go in with a jerk. If they are not, then they won't go in at all, and that's what happened to you. That man who hopped the trolley could have saved himself the yank on his arm if he had turned and run in the direction the car was going.

"YOU know, of course, that with the lever in first gear the motor in the automobile turns over much faster in proportion to the speed of the car than when the gears are in high. Now, when you throw out the clutch, the motor is disconnected from the gearbox, but the section of the clutch that is fastened to the gears just naturally keeps on turning. That means you have to figure out some way to slow it down when you are shifting from a lower speed to a higher one, or to speed it up if you are changing from a higher speed to a lower one."

"Sounds familiar," said Taylor, smiling. "The man who taught me how to drive used to run off a talk something like that, but I never could understand how to apply it to driving an automobile."

"All right, then," Gus answered, "let's put it in a rule-of-thumb way. Just remember one simple rule: Take your foot off the throttle when you shift to a higher gear and keep it on when you shift to a lower one. This works on most cars, because the slight drag in the clutch makes the free part of it speed up or slow down with the engine. If you remember that one simple rule, then all you have to watch out for is the time interval, and you can get that by practice."

"OF COURSE, it doesn't make any difference to other automobilists on the road whether you tear the whole transmission out or not, so long as you are on level ground, but if you are on a steep hill, it's another story. Suppose there had been a bunch of cars right behind you today!"

"Oh, don't rub it in," said Taylor. "I'm a muttonhead all right. But suppose you just show me how it ought to be done on this hill we're coming to. Then maybe I can get it through my head right."

"Good idea," said Gus. "Now you watch carefully. I'll have to shift into second about 100 feet from the bottom."

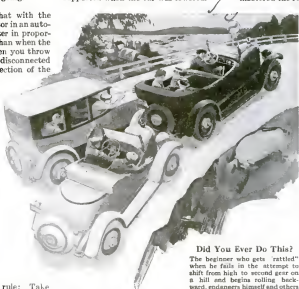
Taylor kept his eyes glued on Gus's feet. When the engine began to slow up, down went the left foot on the clutch pedal just far enough to disengage the clutch, and almost simultaneously the gear lever went into neutral. The right foot remained on the throttle and when the motor had attained just the right speed, Gus eased the lever into second and released the clutch pedal without a suspicion of clash or jerk.

"Gee, that was as smooth as silk," said Taylor admiringly. "It looks like nothing at all the way you do it."

Gus's wrinkled face creased in a smile.

"Just like everything else, Mr. Taylor; it's easy when you know how. As far as auto transmissions go, you can make one last at least twice as long if you treat it right."

A few minutes more and they were in the garage, and Gus busied himself arranging blocks so that the axle would be supported when the car was lowered.



Did You Ever Do This?

The beginner who gets "rattled" when he fails in the attempt to shift from high to second gear on a hill and begins rolling backward, endangers himself and others.

"How soon will the old boss be ready again?" Taylor asked.

"Well," said Gus, with a quick glance around the garage to check up on the jobs that should be finished before Taylor's, "about Thursday afternoon, I guess—yes, I'll promise it by then. I suppose you will steer clear of Smoke Hill after this," he added, with a twinkle in his eye.

"Not sir!" said Taylor. "I'm going up that hill if it's the last act of my life!"

"Better get in some practice on level ground first, then," said Gus; "and, by the way, Mr. Taylor, if you really want to get into the expert class as a driver you might like to know how to do the 'double clutch.'"

"I'll bite," said Taylor, looking puzzled.

"What is it—a joke?"

"Double clutching is no joke," answered Gus. "It's something that most auto drivers know nothing about, yet it certainly is a good thing to know if you hap-

pen to want to make the other fellow eat the dust on a bad hill."

Taylor was interested immediately. "Fine!" he said. "Give me all the dope on that. I never did like the taste of dust anyway!"

"I don't know whether I ought to tell you or not, seeing as how you haven't mastered the regular way of shifting gears yet," Gus began.

"However, if you'll promise not to blame me if you rip out the transmission trying it, I'll explain double clutching."

"REMEMBER how I shifted into second on that hill? You noticed, of course, that I waited till the old bus had slowed down quite a bit before I tried to shift. Now, if you were trying to race a man up that hill, you naturally wouldn't want to wait till the car slowed down; you would want to make the shift while the car was still going good and fast."

"The only way you can drop from high into second when you are going fast is to use the double clutch. Otherwise you would be almost sure to make a lot of grinding noises."

"Here is how you do the double clutch: The minute the car starts to slow down in high, jam your foot on the clutch pedal and throw the gear-shift lever into neutral. Keep the accelerator pressed down hard. Of course, the second the clutch is thrown out and the load of the car is taken off, the motor will start to race to beat the band. With gearshift lever still in neutral, let the clutch in quickly, push down on the clutch pedal again right away, then immediately throw the speed lever into second and let the clutch in again."

"WHAT happens is that while the gear lever is in neutral, the gears you intend to mesh are speeded up by letting the clutch in so that when you push out the clutch and throw her into second there will be practically no clash. That is, if you get the timing right. The only way you can get that is to practice."

Taylor threw up his hands in despair.

"Gosh!" he exclaimed, as he turned to go: "nothing doing on that for me. Guess I'll stick to plain driving. I can't afford a new transmission just for the pleasure of beating some bird up a hill."

"Drat it!" mumbled Gus to himself as he stared after Taylor's retreating form. "Say, Joe, why is it that every bird who succeeds in scraping through the driver's examination decides right away that he is the real thing as a driver and tries to navigate around in heavy traffic just like an old-timer? It would be a lot better for him and for the other fellows on the road if he would spend a lot of time on lonely roads practicing gear shifting and maneuvering the car until he really knew how to do it right."

Do You Know Gus and Joe?

THESE two interesting proprietors of the Model Garage appear every month in POPULAR SCIENCE MONTHLY: If you haven't met them, now's the time to get acquainted. You'll find Mr. Bunn's stories not only highly instructive, but entertaining. Next month Gus and Joe will give you some valuable new tips about tires.

Handy Kinks to Aid the Car-Owner

Seven Ways to Save Time and Expense in Auto Repairs

HEADLIGHT bulbs always seem to burn out just when it is least convenient to replace them. Usually the burn-out occurs on a dark road, late at night and during a heavy rainstorm. And to make matters worse the rim of the offending headlight is generally stuck so tight that no ordinary force exerted by the bare hands will suffice to break it loose.

In such cases a powerful "persuader" can be made from a roll of tire tape; white surgical tape is even better. As shown in Fig. 1, the end of the tape is wound around the edge of the headlight rim and the remainder of the roll serves as a handle on which to pull. Short, sharp tugs will be found more effective than a steady pull.



Fig. 1. Tape can be used to start an obstinate headlight rim that is stuck.

HERE is a method of bracing the Ford motor to cut out some of the vibration. It keeps the cylinder block from wobbling side-wise. The construction is simple enough. Two turn-buckles are used with the ends bent to fit as shown in Fig. 2.

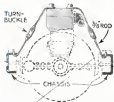


Fig. 2. Turn-buckles used to brace the Ford motor and eliminate some of the vibration.

Care should be used in setting up the turnbuckles, since any excess strain beyond that necessary to get them tight is transmitted directly to the crankcase arms, and if they are turned up too tight a broken crankcase arm may be the result.

THE average automobile owner finds carbon scraping and valve grinding a much more difficult job than it really is, simply because the cylinder head is a rather difficult piece to hold and to work on at the same time.

On overhead valve engines, the valve grinding and assembly of springs and parts can be done much easier if some form of holder is provided for the cylinder head. The method of supporting and holding the cylinder head shown in Fig. 3 will be a big help on carbon-removal and valve-grinding jobs.

In this arrangement, four rods are spaced and secured by bolts through the top of the workbench. This design is particularly good for the amateur workman because the bolts can be removed after the job is finished and put away so that they will be ready for the next time.

The height of these supports should be made sufficient so that the valves can be removed and replaced without disturbing the position of the cylinder head.



Fig. 4. How to align front wheels to secure correct toe-in.

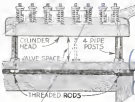


Fig. 3. This method of supporting and holding the cylinder head is useful in removing carbon and grinding valves.



Fig. 5. Serviceable oil clips can be made cheaply and easily from sheet-metal strips and wick.



Fig. 6. Hose clamp made from wire and a single cotter-pin.



Fig. 7. Simple cover made from wire and a single cotter-pin.

the center line of the other rear tire, you can be sure that the front wheels have the correct amount of toe-in.

Of course the test should be made on a level floor and the tires should be properly inflated. Remember also that this rule does not hold good with over-sized tires nor on cars having a longer wheel base than approximately 100 inches.

WHEN the spring leaves are dry, every little bump in the road is transmitted to the chassis of the car. Roads that are full of small bumps, such as cobblestone streets, are negotiated more easily if the springs are kept well oiled. An occasional splash of oil does the trick, but it is better to have some means of constantly feeding oil in between the leaves.

Serviceable oil clips for this purpose may be constructed cheaply and easily of some sheet-metal strips, 1 by 7 inches, with three holes in each. Dent down the metal around the center hole, using a ball-peen hammer as shown in Fig. 5. Then when the metal is bent around the spring with a piece of lamp-wick under it, the center hole will form a small pocket that projects upward and can be filled from an oilcan.

The best way is to have eight clips in all—one on each side of each spring shackle. A little kerosene mixed with the old crankcase oil will make the oil penetrate between the leaves and lubricate them properly.

THE illustration in Fig. 6 shows how to make a very serviceable hose clamp from a piece of wire and a cotter-pin. The brass wire sold on spools for automobile use is suitable, and it is a good idea to use a good size cotter-pin, so that the strain of tightening the wire will not pull it out of shape.

After the wire is arranged as shown in the drawing, it is drawn tight around the hose by turning the cotter-pin with a nail. An advantage of this method is that the clamp can be made of any desired size.

PERHAPS the most difficult part of valve grinding lies in making sure that none of the valve-grinding compound drops into the cylinders accidentally or down around the valve-stem guides. Part, at least, of the worry on this subject can be eliminated by the use of a cylinder cover constructed and used as shown in Fig. 7.

Heavy cardboard or wallboard will do for the material and holes can be cut at the points where the valves are located. Cylinder-head bolts or studs with winged nuts can be used to hold the cover in place. Another advantage of using a cover over the cylinder openings is that no dust from the air can settle in them.

RIFLE shooters call the process "sighting-in" when they adjust the sights on their rifles so that they coincide with the spot on the target which is being hit by the bullets. The same system can be used for lining the front wheels of an automobile so as to secure the correct toe-in.

For the average small car, set one wheel so that a sight taken across the inside of

the front tire near the axle strikes the center of the tread of the rear tire, as illustrated in Fig. 4. Then look across the inside edge of the other front tire and if you find that the line of sight also strikes



The Home Workshop

Arthur Wakeling, Editor

Fitting Up an Unfinished Attic

How to Reclaim Waste Space in Your House—Setting Joists—the Flooring

By Edwin M. Love



FIRST in a new series of articles containing invaluable pointers on house woodwork for every homemaker

IN MANY homes there is sufficient attic space for the building of a needed den or bedroom. If no staircase is present, such a room may be made accessible by means of a disappearing staircase in the hall, or even by a ladder if the room is to be occupied by a man or a boy.

Oftentimes light and ventilation may be had by the use of windows already in the gables, or by substituting windows for ventilators. If, however, there is no direct means of getting light, one or two dormers harmonizing with the architecture of the house may be constructed. Figures 1 and 2 (upper drawing) illustrate these possibilities.

Although each house is a problem unto itself, certain rules of construction cover all cases, so that a careful following of the steps in building an attic room in a typical house will illustrate the principle of any such work.

Ceiling joists usually extend acrosswise of a gabled roof, tying the walls. For reasons of economy, in this typical plan it is desirable to run the attic floor joists at right angles to the ceiling joists, making use of the shorter spans, but necessitating their being placed above the ceiling joists. This is desirable even when the floor joists are to be parallel to those of the ceiling, since any weakening of the timbers because of cutting for electric wires is avoided. As the greatest span is 12 ft., 2 by 10 in. fir stock is used, but local ordinances may demand heavier scantlings than these. All should be sized to a uniform width.

Pass up through the hall scuttle a num-

ber of the planks and distribute them as in Fig. 5, page 110, to serve as a working stage. Drop a plumb hob from the ridge comb (a weight suspended from a cord is sufficiently accurate for this purpose) to determine the center of the room, and lay out the width, which in this case is 11 1/2 ft.

For bearings for the floor joists, fit 2 by 4 in. blocks on the bearing plates, using two thicknesses, which should rise above the tops of the ceiling joists 1/2 in., giving clearance for the beams. Lay off distances of 16 in. from one side, making an X beside each mark to show on which side the joist is to bear. The space at the other side of the room is less than 16 in., but if no great load is to be carried, the distance may be divided to save the extra joist shown in the photograph (Fig. 3).

Remove the roof braces shown in Fig. 4. Select a straight joist and set, crown edge up, at one side. Test for levelness by means of a straight-edge and level. The ends of the straight-edge should be supported by blocks

of equal thickness to avoid errors due to curvature in the joist, as shown in Fig. 2. It is preferable to cut away the bearing edge of the high end, but if this brings the beam in contact with the ceiling joist below, shim up the low end with a strip of wood.

(Continued on page 110)

This month's Home Workshop Department will be found on pages 79 to 82 and 88 to 111, The Shipshape Home on page 86, and The Better Shop Methods Department on pages 84 and 112 to 120.



Fig. 2 (at right). House with added attic room and details showing methods of setting and bracing floor joists, bridging and laying the floor

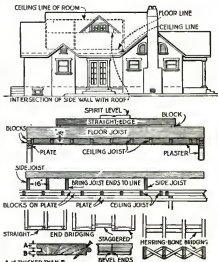


Fig. 3 (at left). Model showing framework of flooring laid to center of room prior to nailing the upper ends of the herring-bone bridging

Carving with Your Pocket-Knife

Simple Checker-Board Ornamentation for Small Boxes

YOUR jack-knife, a hammer, and a few nails are all you need to make these handy little boxes with their decorative checker-board pattern.

The same pattern can be applied to a great many articles — picture frames, vanity boxes, smoking cabinets, hook ends, stationery racks, and all sorts of woodwork. For any one who has not discovered the fascination of jack-knife work and wishes to learn to whittle, this type of carving will commend itself because of its simplicity.

Butternut wood was used for the handy little toolbox illustrated in the right-hand column, because it does not split easily and the grain is generally straight. It is easy to work with and, when finished, its color looks like some of the harder woods. However, any clear, fine-grained wood, such as white pine or basswood, is suitable. White pine was used for the smaller vanity box shown at the top of the page.

Make the box for your own requirements. With pencil and ruler or try-square, draw squares of about $\frac{1}{2}$ in., leaving a border around the outer edge. A touch of beauty and artistic workman-

By Herbert I. Childs



Herbert I. Childs, of Worcester, Mass., an authority on pocket-knives and the almost lost art of whittling, and a vanity box he carved to illustrate the very simple and effective checker-board pattern he describes in the accompanying article. Other articles on useful pocket-knife work are to follow.

the blade is too flat in relation to the stone, the edge will be too thin for strength in ordinary use. It is sometimes desirable, however, to sharpen with a thin edge when very light, thin cutting is to be done. On the other hand, if the blade is held at too great an angle, it will not cut properly, as the shoulder will strike the work before the edge when the knife is held in the natural manner for whittling.

To insure good results, you should have a knife that fits your hand fairly well. It should have a large blade for rough or straight work and one or two small blades for the finer details. You cannot be too



A small toolbox of butternut wood decorated with checker-board chip carving and initials.

Your initials may be cut in or raised.

If to be raised, cut out the surface around them as far as the border to a depth of $\frac{1}{16}$ in.

Sandpaper the flat surfaces of the box and finish with shellac, wax, or varnish. The wood can be stained, if you wish, before the finish is applied.

For the sake of your knife as well as your work, do not use a dull knife. As soon as it does not cut clean, sharpen it. Use a fine-grain oilstone with a flat surface, upon which a few drops of clean oil have been placed. If sharpened on a dry stone, the edge is likely to be rough.

For general use, the edge of the blade should rest on the stone at an angle of about 20 degrees. Draw it from heel to point across the stone from right to left; pass the blade over and draw it across from left to right. The stroke is always against the cutting edge and not with it, as is the case when stropping the blade on leather. The beginning of a stroke from left to right is illustrated above.

Keep up the sharpening process until the edge is keen. This may not come to you at first, but after you have tried it a few times you will see the advantage of taking this care in setting the edge. If

careful in your selection, for you cannot get good results from a poorly manufactured knife.

The first essential is a knife with a fine quality of steel in the blades, accurately tempered to a hard, high, and tough temper. The blades should be carefully ground with truly tapered sides. Many knives on the market are of a low grade of steel, poorly tempered and ground, and have no value for whittling and carving work. Avoid these and select one of the high grade, American-made pocket-knives, which can be made as keen as a razor.

A GOOD knife will be sharp when bought and for a long time should require only an occasional touching up of the edge on an oilstone. Unless a pocket-knife is permitted to get into very bad shape, it should rarely require grinding.

While the usual spear-shaped blades in the regular jack-knife are suitable for general whittling, it is useful for special carving to have a narrow, straight-edged, small blade with a long point, the hack curving down to the straight edge. This is called a "Wharncliffe" or "sheep's toe blade." A so-called Sloyd or modeling blade usually has sides that do not begin to slope toward the edge until about halfway across the blade. With its thick, heavy back, this also is known as a saber-shaped or full-swaged blade. A clip-point blade is one that is similar to a Turkish sword or scimitar, the back half being hollow ground or concaved before reaching the point.



Wedge-shaped chips are removed from alternating squares after scoring lines.

ship is added if a square or diamond is marked out in the center of the pattern. This should be in good proportions to the squares, as in the illustrations. Your initials will look well within the central space.

Cut every line to the depth of about $\frac{1}{16}$ in. with a small, sharp blade of your pocket-knife. Then carve out the alternate squares, beginning at the bottom of each square and tapering in toward the top until upon reaching it you have cut to the depth of a full $\frac{1}{16}$ in. This will be understood better if you will glance at the cross section in the drawing at the right.



Suggestion for laying out the front of a box with initials in a central rectangle.

How to Repair an Electric Iron

When the Heating Element Burns Out, It Can Be Mended by Joining the Ends of the Broken Resistance Wire

By Leroy S. Foltz

Professor of Electrical Engineering,
Michigan Agricultural College

"I WONDER what's wrong with the electric iron? It won't heat up."

How often this complaint is heard! Yet a modern electric iron is practically indestructible and hardly anything can go wrong with it that cannot be repaired quite easily by any handy man.

When an iron fails to heat, the break in the electric circuit may be either in the cord or within the iron itself. It is well to test the iron with another cord, if one is available; otherwise examine the cord with care, especially near the attachment piece. Take the cover off the attachment piece and see if the wires are connected tightly with the terminals. If you have any further suspicion of the cord, test it by the means previously described in *POPULAR SCIENCE MONTHLY* ("How to Test and Repair the Cords of Household Electric Appliances," July, 1925, page 92).

When you are certain that the difficulty is within the iron, the first step is to dismount it. This necessitates removing the parts that interfere with the exposure of the heating element. Figure 1 shows the initial step in removing the handle; Fig. 2, the removal of the terminal block. In some types of irons the terminal block and handle need not be removed.

Next, take out the main assembly screws, which hold the top of the iron in

position. This will allow the top to be lifted off and the element to be exposed.

An examination of the heating element will reveal the location of the trouble. In this case the element has burned "open," as shown in Fig. 3. It is necessary to connect these two ends in such a way that the joint will not melt when the current is applied. To accomplish this, unwind the wire ribbon each way to the other side of the element (Fig. 4). Clean

about 2 in. of each end thoroughly with a piece of emery or fine sandpaper.

Now form one end into a flattened coil of two or three turns and insert the other end into it. Reduce the size of the turns and pull up the slack in the wire. With the pliers, flatten the coil firmly down on the inserted end of the wire, as in Fig. 5. Be sure to have the coil flat so that projections will not wear holes through the adjacent mica. In order to prevent the joint from interfering with the wires on each side, it is well to insert a small sheet of mica under it, as in Fig. 6.

The element now may be tested by applying voltage to the terminals and noting how the joint performs. If it becomes excessively hot, it should be adjusted to give a larger and more uniform contact between the wires.

When the iron is reassembled, the pressure put upon the element will improve this contact. Be sure to have a little extra mica both above and below the joint—between the element and the top and bottom of the iron.

In case the resistance wire has become so badly damaged that it cannot be repaired in this way, it will be best to discard it entirely and to purchase a new heating element. These come fastened between sheets of mica, ready for insertion.



Fig. 1. To disassemble the average iron, it is necessary to remove the handle. This is not required, however, with some types of irons that are so designed that the element can be uncovered quickly.

Steps in Fixing an Iron

These illustrations show graphically the steps required in fixing an electric iron. This is one of the most frequent, as well as one of the simplest, repairs the home worker is called upon to make.



Fig. 2. Having removed the handle, the next step is to unscrew and detach the terminal block. Then remove the main assembly screws, which allows the top to be lifted off and the mica insulation removed. Screwdrivers and pliers are the only tools required. Whenever taking apart any electrical appliance, make a careful mental note of the exact position of each piece before removing it.

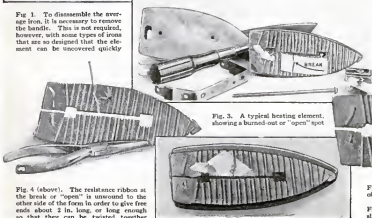


Fig. 3. A typical heating element, showing a burned-out or "open" spot.

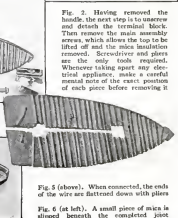


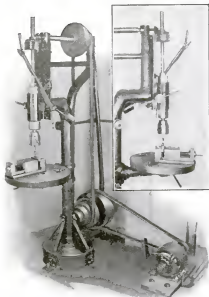
Fig. 4 (above). The resistance ribbon at the break or "open" is unwound to the other side of the form in order to give free ends about 2 in. long or longer enough so that they can be twisted together.

Fig. 5 (above). When connected, the ends of the wire are flattened down with pliers.

Fig. 6 (at left). A small piece of mica is slipped beneath the completed joint.

Drill Press Built from Scrap

Has Seven Ball Bearings Salvaged from Junked Automobiles



By Ray F. Kuns

Principal, Automotive Trades School,
Cincinnati, Ohio.

ORIGINALLY designed for a home workshop, the drill press illustrated looked so well when completed that it was placed in a shop, where it is giving complete satisfaction in constant service.

One of the most interesting things about this drill press is the fact that incorporated in it are seven ball bearings, all salvaged from automobiles. In fact, a great part of the material was taken from dismantled cars. With hundreds of thousands of automobiles being scrapped each year, there is an ever increasing field for the use of their parts in building up special garage, machine-shop, or home-workshop equipment.

No attempt has been made to give detailed dimensions. The success of a piece of work of this kind depends largely on the ingenuity of the mechanic in making use of the parts at hand. The main part of the machining may be performed on an engine lathe.

The base *BD* is a heavy brake drum with four pieces of 3-in. angle riveted to it for feet. A hub flange, which has been bored out to receive the pipe *G*, is bolted or riveted to the brake drum.

The frame is built up by welding pipe together. *G* is a piece of 3-in. gas pipe. The curved arm *F* is a piece of 2-in. exhaust pipe, the curve being the original one. *E* also is a piece of exhaust pipe, about 1½ in. The brace *E*¹ is not added until later.

The table support must be planned before the frame is assembled on the base, unless a split support is devised in place

of the cast-iron tee, *I*. The pipe *G* is not turned in the lathe, but simply has any unusually rough spots knocked off with the file. The 3-in. cast-iron tee *I* has a 2-in. outlet for *F*¹. It is chucked and bored so that it is a sliding fit on *G*. The two ½-in. screws *Z* are used to lock the table at the desired height.

The block *N* is a piece of 1-in. steel large enough to receive the ball bearing selected for this point. It is welded to the post, after being bored on the lathe to take the ball bearing.

*N*¹ is another piece of 1-in. stock and is bored to carry the bearing supporting the other end of the shaft that carries the lower cone *P* and the tight and loose pulleys *M* and *M*¹. *N*¹ is welded on a bracket built up to the height of the brake-drum base. *BB* is a

length of ¼ by 2 in. flat machinery steel, and the bar *BP* is ¾ by 6 in. flat steel.

The lower shaft *O* is made up from an axle shaft and has the ends machined to fit the bearings; the other parts are machined to care for the pulleys.

Both cones are the same size and are built up from 1½-in. oak or other hard wood. The particular machine illustrated is provided with both a tight and loose pulley. This allows for connection with a line shaft or individual motor, as shown in the photograph. The pulleys *M* and *M*¹ are 12 in. in diameter. They may be made from old brake drums.

The table *C* was made from an engine flywheel. It was faced off in the lathe and the edge turned down to 1½ in. thickness. The end of the crankshaft *X* with the flange *Y*, which fits the flywheel, forms the table mounting.

H is a 2-in. cast-iron tee. If *X* is not large enough to permit boring the tee, it may be bushed by screwing short or close nipples into each of the ends and then the tee is chucked and bored to receive *X* as a sliding fit. The length of *F*¹ will depend on the swing of the drill. It should bring the center of the table under the center of the drill bit. The screw in the 2-in. tee locks the table in any desired position.

The building of the drill-press head is, of course, the most difficult part. *F*² carries two ball bearings, one in either end. These in turn carry the shaft *A*.

Another ball bearing in *C*² carries the driven gear *W*. These three bearings must be in line. The plate *D*, which is a piece of steel plate ¾ by 6 by 19 in., is welded to the pipe frame.

*F*² may be a piece of 2-in. pipe or tubing. A shoulder is provided when boring to allow the ball bearings to strike it when they are pressed in.

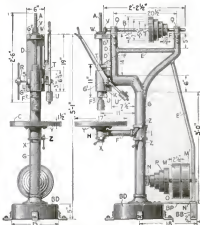
The spindle *A* is machined to assemble from the bottom of *F*² so that it has a shoulder to take the thrust. Ball bearings are usually made to take a thrust in one direction only and this point should be considered in selecting and mounting these bearings.

THE rack *J* is screwed to the part *F*². The shaft *S*, which carries the pinion that actuates the rack, is carried by two blocks of steel, *LL*. One end of this shaft carries a plain lever bar marked *R* and the other end carries a ratchet gear. This gear is engaged and operated by the lever *T*, also salvaged from a car. The lever is balanced by the weight *U*.

*G*¹ is a piece of tubing with a bore to accommodate *F*² in a sliding fit and machined to allow the rack to project at the rear. It is supported by two strips of angle iron. These strips, *K*, are welded to the tube *G*¹ and house the rack and rack pinion. They in turn support the blocks *L* and when mounted to the plate *D*, support the entire lower part of the drill-press head.

The gears are salvaged from a car. *V* is one of the little gears from the differential. It is a spider gear, and drives a side gear *W*. The ratio is about 2 to 1, which is usual practice. *W* will be found to have a collar-like flange on it, and this

(Continued on page 108)



Front and side views of assembled drill press made mainly of material reclaimed from the automobile junk yard

How to Finish Furniture —New and Old



JOHNSON'S WOOD DYE

(Penetrating)

If you have a hobby for making chests, cabinets, furniture, porch swings, radio boxes, etc., you will find our book on Wood Finishing invaluable. For, naturally, you want to give your handiwork a beautiful finish.

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"The Wood Finishing Authority" (Canadian Factory Brantford)



Better Shop Methods

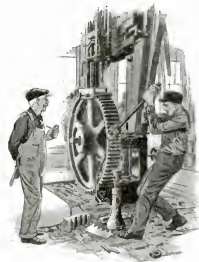
How Expert Mechanics Save Time and Labor



Chasing a Difficult Thread

Old Bill Repairs a Pump and Renews a Gear

By James Ellis, *Machine-Shop Superintendent*



OLD BILL put down the trade paper he was reading. He rarely found time to read anything for more than a few minutes before some one opened the door that separated his office from the noise of the shop.

"This pump I am working on—" began the machinist who had entered.

Old Bill smiled and nodded. He knew the job. It was a duplex steam pump that had been sent to the shop for a general repairing.

"One of the water valve seats," the machinist went on, "has come out of the casting, and the threads are all worn off."

Old Bill followed the mechanic out of the office, for he had promised to have that pump back in service on the following day. It was mid-afternoon, and here was something else to be done.

The pump was on a big radial drill press, having the seats faced off. The tools for facing the seats were something like an end mill, except that the teeth went entirely across the face. There was a pilot to go into the hole in the middle of the valve seat, and a shank to fit the drill-press spindle.

"I had them all done but this one," the machinist said, "and about the time I got the cutter in contact with it, I noticed that the seat turned. I stopped, and it came out with my fingers. The threads are gone from the casting as well."

Old Bill saw that the brass seat had only the semblance of threads, and the casting had been attacked so much by rust and by the slight movement of the seat that it had no threads at all. And the pump must be delivered the next day!

Old Bill knew that he could build up the brass valve seat with a welding rod and re-thread it again without much trouble, but to get some threads into the pump casting was another question. The cylinder and the frame were one casting, so chasing a thread in a lathe was out of the question. He thought of taps. But when he measured the valve seat, he knew that he had no tap that was $4\frac{1}{2}$ in. in diameter.

"How about reaming the hole and driving the valve seat in?" the machinist suggested.

"Some of them are made that way."

"We might make a tap," ventured another mechanic, who had stopped to look.

"I promised to have this pump done in the morning, and we should not be able to make a tap in that time, even if we could find a piece of steel already annealed," Old Bill said. "I believe the best way will be to chase another thread and screw the valve seat back in."

One man opened his mouth; the other closed his eyes a trifle.

Old Bill handed the valve seat to the machinist on the job and said, "Get the welder to build up the thread right away."

The mechanic reluctantly left on his mission, for he was anxious to hear the idea Old Bill had in mind.

"WE WILL chase the thread here on this drill press," Old Bill told the machinist who remained. He smiled at the incredulous look of the machinist and continued, "Don't scowl so! All you have to do is to make a boring-bar with a thread, and a guide with a threaded hole that you can bolt across the top opening."

Old Bill looked around the base of the drill press. There had accumulated a mass of bolts and clamps that were used to set up work. He selected a bar about 1 by 3 in. and something like 2 ft. long.

"This will make the guide," he said as

he laid the piece over the top of the chamber. "Now get a threaded hole about here." He made a mark on the bar just over the worn hole. "I think that we had a $1\frac{1}{2}$ -inch tap with eight threads to the inch made for some special job. If you can find that, it will be fine. Then make a boring-bar to fit the threaded hole. You can turn a straight shank on it and hold it in the drill chuck. Hold the tool with a setscrew."

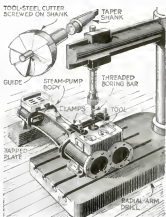
The machinist grasped most of the idea. Old Bill went on: "I forgot to say that you should hold the guide bar on the chamber with some of the studs that hold on the cover. They are right where you want them."

This was something new to the machinist, but he set to work to get the parts ready. The other machinist was back by this time, and after the idea had been explained to him, he started to make the boring-bar. With two men at it, the tools were soon well under way.

Old Bill, resisting the lure of the article he had been reading, made the rounds of the shop and came to a gear about 4 ft.

(Continued on page 115)

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, which you will find on pages 112 to 120.



Radial drill set up for threading, and facing tool with teeth neither radial nor evenly spaced



#186

Starrett

Why Do Good
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Compare Starrett Calipers and Dividers with other makes and you will begin to see why Starrett Tools are preferred by particular mechanics everywhere. You'll find them made from a fine quality steel, tough and nicely tempered. The legs are strong, the springs have just the right stiffness for rapid, easy work, yet holding a given size faithfully. Set a pair of Starrett Calipers or Dividers in the morning and they stay set all day. The adjustment is particularly

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The Shipshape Home



How to repair shingle, composition, slate, and metal roofs—A simple "creeper"—Painting roofs

How to Repair Leaky Roofs

MANY a homeowner who takes pride in keeping his house shipshape is at a complete loss when it comes to roofing repairs.

This is natural, because the roof is usually an inaccessible and awkward place to work. Yet, a little care given to your roof, whether it is shingle, composition, slate, tile, or metal, will repay you greatly.

By looking after a roof from year to year, its life can be preserved surprisingly and, of course, the annoyance and often costly damage caused by leaks can be avoided.

There is nothing especially difficult in repairing a roof, provided you know how to go about it. If you have a shingled roof and it leaks, go into the attic and wherever daylight shows through, drive small splinters of wood up into the cracks. These will indicate the cracks when you are working on the outside. If no light is visible, note the approximate location of the tell-tale damp spots.

Put your ladder up outside and set your "creeper" or roof scaffold in place. If you have no creeper, by all means make one, as it will be useful for years to come. In case of a roof fire it may aid greatly in reaching the flames.

Almost any board that is as long as the roof from the eaves to the ridge will serve as a creeper. Nail cleats to it about 1 ft. apart. The upper end should have a hook as shown; this can be purchased or forged from an iron bar. Bolt it securely to the creeper. After placing the hook over the ridge, always test by pulling down sharply on the creeper before trusting your weight on it.

FIT new shingles into any places where the old shingles are out, nailing them in place. Where the shingles merely are split, slide pieces of tin or galvanized iron under them far enough so that the upper part is under the top course of shingles. Nail down all loose shingles and replace any badly damaged ones.

A coat of good shingle paint will aid in preserving the roof. A very economical paint can be made by mixing 5 gals. colored creosote shingle stain, 3 gals. old auto oil, and 2 qts. of Japan drier. Mix more or less, according to the size of your roof, but use the same proportions. Brush on exactly as paint. By adding aniline dyes of the shade desired, almost any color, if not too light, can be obtained. I should not recommend this paint for shingled side walls, as it would remain tacky for some time.

If your roof is of the composition shingle type, mark the leaks as for wood shingles,

or note their approximate positions and proceed in the same way, except that a small dab of roofing cement the color of the shingles should be applied over each nail. If you cannot obtain roofing cement of the right shade, mix asbestos fiber, which can be had from almost any plumber or steamfitter, with a paint of the proper color until a putty-like paste results. This filling for small holes and cracks will last for years and will remain flexible.

If the shingles have dried out or the surface has gone, there are a number of colored paints with an asphalt base that may be used to renew the life of the roof. Under no circumstances use paints with

up even with the other slates in this course and bend the copper clip up in hook fashion. This will hold the slate permanently in place.

If a slate must be cut, lay it along a stone step or a square piece of iron and cut it with an old file or hatchet by using short, sharp blows. Holes can be punched with a sharp nail or punch. If any large amount of slate must be cut, it is best to employ an experienced slater or to purchase a set of slater's tools, which consist of a hammer, ripper, and stake. The latter is a T-shaped, flat steel anvil.

If your roof is tile, by all means get an experienced roofer. Tile roofs are difficult to repair because the tile must be laid to allow for expansion.

Metal roofs are perhaps the easiest for the amateur to repair. Solder or cement all small holes or cracks and then paint them with a good grade of iron oxide or red lead paint. If the roof is loose, fasten it down with large headed screws and solder or cement over their surface.

To do a good job of soldering a metal roof, scrape the metal until dry and clean and use a good flux (muriatic acid for galvanized roofing and rosin for tin roofing). Solder heavily with a clean, hot iron.

IF YOU wish to make your own paint for galvanized iron, use the best red oxide paste and thin with pure boiled linseed oil to the proper consistency. Brush this with as much care as if you were painting the house, and your roof will last for years.

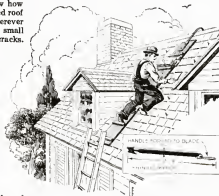
When working on your roof, always fasten down all metalwork around the chimneys or dormers and be sure when painting valleys on a shingle roof to crowd the paint up under the edges of the shingles, as it is here that 90 per cent of the leaks in the valleys occur.

If copper valleys have been used, an agreeable color can be obtained by painting the metal with a solution of vinegar and salt water. This turns the copper a bright green, which contrasts beautifully with the duller slate or shingled surfaces.—C. W. HUBERTZ, Corry, Pa.

Polishing Furniture

PROFESSIONAL furniture finishers generally are agreed that lemon-

oil polish is the most satisfactory for regular use. Another good polish that cannot harm the finest furniture is 1 pt. neutral oil and 2 heaping teaspoons whiting mixed. Add 1 qt. water and shake well. By adding a generous quantity of rottenstone powder to this polish, it becomes an excellent abrasive for improving old, duster-scratched pianos.



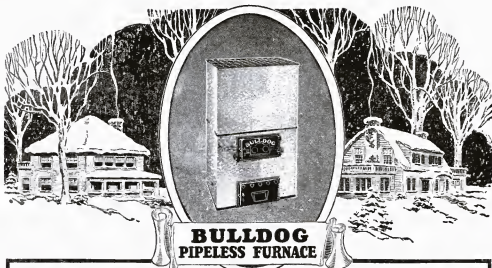
Using a "creeper" in repairing a shingled roof. A tool for removing broken slates

a linseed-oil hane on a paper roof as such paint will destroy its weather-resistance.

If your roof is slate or tile, an entirely different method of repair is necessary. Go over the surface of the roof carefully and remove all slates that are cracked crosswise of the slate. Use the tool illustrated, which any blacksmith will make for a dollar or two, or which can be purchased from a hardware dealer. It is called a "ripper."

INSERT the working end under the broken slate and move it back and forth until the nail holding the slate in place is firmly seated in one of the hook-like notches. Then by jerking down sharply the nail can be cut. If it is too stubbornly set, the upper end of the handle may be hammered.

In the crack or joint directly under the slate that has been removed, nail a piece of copper or soft brass about $\frac{1}{2}$ in. wide and 4 in. long in such a way that the lower end will project 1 in. below the lower line of the course where the new slate is to go. Then slide the new slate



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Half the Coal!

"I had a hot air furnace in our 7-room house before I got the Bulldog and our house was always cold. With the Bulldog it only takes *half as much coal* and we had weather below zero, and the house was nice and warm in the morning when we got up. We never

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"Your letter received asking about the Bulldog furnace. We have had ours in about six weeks and so far it does all Babson Bros. claim for it. We have seven rooms, four on the first floor and three on the second, and it heats them fine. We find it takes a little more coal to heat the whole house than it did to heat one room with a stove using chestnut coal. — J. B. Smith, 15 Elm St., Somerville, N. J.

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"I can run my Bulldog furnace for fourteen days in normal weather conditions on the actual cost of fifty cents." So writes F. R. Redetske, of Cleveland, North Dakota, and

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If, for example, you wish to make a tea wagon such as the one illustrated, you can work without any definite plans, piecing the parts together as you go along and trusting to luck that the assembly will be good looking when finished, or you can make a working drawing of your own, which is a time-consuming and rather difficult undertaking for the average amateur woodworker, or you can obtain for 25 cents a blueprint with the complete drawings and bill of materials showing the exact size of each part. Merely to state these alternatives is sufficient to indicate which is the easiest and the one most certain to produce satisfactory results.

The truth is that the more experienced a mechanic is, the more certain is he to use a drawing to work from, whenever possible. Even if he wishes to change the size or shape or modify any of the details, he still wants to have a drawing that will

serve as the basis for the main construction. It gives him the necessary starting point for his work.

If you have not yet taken advantage of this service, why not try one or more of the blueprints? It may aid you in making a selection if you know that the most popular blueprints have proved to be the tea wagon (No. 13), the sewing table (No. 1), the smoking cabinet (No.

2), the kitchen cabinet (No. 5), the workbench (No. 15), and the cedar chest (No. 17).

Unless you have a good bench and ample storage space for your tools, it will pay you to start by making the cabinet bench. Not only does it provide a working top of generous size and the most rigid construction, but it contains several convenient drawers

and compartments for tools and materials.

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In ordering any of these, please use the coupon below.



A solid walnut tea wagon made for \$30 by H. Caldwell from Home Workshop Blueprint No. 13

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by Manipulating
Small Figures



A pair of boxing dolls ready for a battle. Their arms are controlled by the contestants, who put them through the motion of fighting and endeavor to punch in the pins

At left—Dressing a papier-mâché doll in trunks and inserting one of the markers which are designed to register blows

TWO papier-mâché dolls, four pieces of wire, some nails and putty and cloth, all not costing more than 40 cents, can be made into an amusing boxing game.

The arms of the dolls are operated by the two contestants. Each tries to win a "knock-out" by manipulating his boxer so that it punches in each of the three buttons exhibited by the opposing doll pugilist.

The dolls, as purchased from the variety store for 15 cents each, are dressed in white tights and black trunks. Nails with putty buttons molded on the beads serve as the targets and indicators. Large



glass-beaded pins, if cut short, will serve as well. The lowest of the three photographs shows one of the targets about to be inserted in a boxer's forehead. The gloves are made of putty and molded on the boxers' fists;

Practice and quickness of hand and eye are necessary to "down" the opposing boxing doll by punching home the three little buttons.—KENNETH B. MURRAY.

Those who have been following Edward E. de Lancy's series of model-making articles will be sorry to know that illness has delayed temporarily the preparation of the concluding article.

To Keep Rats from Brooder House

BBROWN rats, which destroy a disheartening number of small chicks every season, make their nests under the wooden floors of brooder houses. To keep the rats out, a satisfactory method is to remove the floor, being careful not to damage the boards, and remake it in sections similar to hatching doors.

If the building is small, one door or section on each side will be sufficient; if large, make one for each side and end, leaving that part occupied by the brooder stove solidly nailed to the floor timbers.

Nail one board securely at each side and



A brooder house, showing raised section of floor and diagram of typical arrangement of hinged flooring

end of the building and barge the various sections to these border pieces. The sections then can be raised instantly and rats routed out and their nests destroyed.

Another advantage of having the floor in sections is that when the house is not in use, they can be raised, thus keeping the ground dry and thereby preventing the decay of the foundation timbers and the floor. The cost need

not be more than the price of the hinges required, a little lumber, and a few nails. The work itself can be done in spare time.

—J. R. KOONTZ, Bremen, Ind.

NEW! Radically different!



No. 486 Eveready Layerbilt "B" Battery, 45 volts. Length, 8 3/16 inches. Width, 4 7/16 inches. Height, 7 3/16 inches. Weight, 14 1/2 pounds. Price, \$5.50.



It's all battery. With every cubic inch packed to capacity, it contains about 30 per cent more electricity-producing material. All chance of loose or broken connections avoided by contact of full area of carbon plate against zinc plate. The scientifically correct construction.

The greatest improvement ever made in "B" Batteries

ABSOLUTELY new in construction—perfected through years of research, the new Eveready Layerbilt "B" Battery is as superior to the old type "B" Battery as a tube set is to a crystal.

Heretofore, all dry "B" Batteries have been made up of cylindrical cells—no one knew how to make them any other way. The new Eveready Layerbilt is made of flat layers of current-producing elements compressed one against another, so that every cubic inch inside the battery case is completely filled with electricity-producing material. Layer-building heightens efficiency by increasing the area of zinc plate and the quantity of active chemicals to which the plate is exposed.

After the most rigid laboratory tests, more than 30,000 of these new Eveready Layerbilt "B" Batteries were manufactured and tested by use under actual home-receiving conditions. These tests proved that this new battery is far superior to the famous Eveready Heavy-duty Battery No. 770, which up to now we have ranked as the longest lived "B" Battery obtainable.

On 4-tube sets, 16 mil drain, it lasts 35% longer.
On 5-tube sets, 20 mil drain, it lasts 38% longer.
On 6-tube sets, 24 mil drain, it lasts 41% longer.
On 8-tube sets, 30 mil drain, it lasts 52% longer.

The new Layerbilt principle is such an enormous stride forward in radio battery economy that we will bring out new sizes and numbers in this Layerbilt form as fast as new machinery is installed. For the present, only the extra-large 45-volt size will be available.

Buy this new Eveready Layerbilt No. 486 for heavy drain service. It far exceeds the performance for which Eveready Radio Batteries always have been famous and is, we believe, by far the most economical source of "B" current obtainable.

Manufactured and guaranteed by
NATIONAL CARBON CO., Inc.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR EVERY TUESDAY at 8 P.M.
Eastern Standard Time
Beginning Sept. 10th, 8 P. M. Eastern Standard Time
For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—
WEAF New York WGR Buffalo WWJ Detroit
WJAF Providence WCAE Pittsburgh WOOD Minneapolis
WEEL Boston WCAE Cincinnati WCC St. Paul
WFI Philadelphia WEAL Cincinnati WCC Des Moines

EVEREADY

Radio Batteries

-they last longer



Your Hammer

If you're particular about your tools

When you grip a Maydole you feel as if it was made specially for you.

No other hammer has its marvelous "hang". It's the result of eighty-two years of painstaking development.

And the Maydole has a strength and stamina that's worthy of its design. The head is of press-forged steel, tempered separately at each end for the particular work it is to perform. The handle of clear second-growth hickory, air-dried for years. It's made tight and it stays tight.

For real hammer service and satisfaction, make sure that "D. Maydole" is stamped on the head of every hammer you buy, whether it's a nail hammer, machinists' or any other type of hammer.

Your dealer will gladly show you the Maydole you need.

Write for free pocket handbook 23 "B".

THE DAVID MAYDOLE HAMMER CO.
Norwich, New York



The Home Workshop

Handy Toolbox for Your Car

By H. T. Shrum

Instructor of Auto Mechanics
State Normal School, Oshkosh, Wis.

ANY one who has toured the country much and has taken care of his car, doing the oiling and minor repairs himself, will appreciate the toolbox arrangement illustrated, especially if it is possible to install a similar one in his own machine.

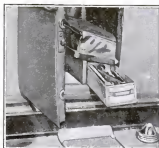
For two years the writer had a small sheet-metal box in which the most used tools were kept. So that it would be handy for changing a tire or to make some slight repair, it was kept on the floor board just under the edge of the front seat.

When the spare tire was needed, all tools including the jack were available and it was not necessary for the occupant of the other front seat to move in order to get at the tool compartment under the seat.



How the toolbox and slide are made

the car was parked. For these reasons a box was made to slide under the front seat, after the block which closed up this space had been removed.



Simply made sheet-metal toolbox that slides under the front seat of an automobile

There were times, however, when the open tool box was in the way or the tools seemed unduly exposed to strangers when

over to strengthen and finish the top edge. A handle on each end is provided so that the box may be carried to the work after it has been withdrawn from the slide.

The slide is built much like a box lid, open at one end and with a hem turned on the edges to finish and strengthen them. It is riveted at the corners and then screwed or tacked in place to guide the box under the seat and keep it in place. The tools may be kept from rattling by lining the box with carpet.

Mailbox Supported by a Swinging Arm

RURAL mailboxes that can be swung to the side of the road have three advantages: They can be turned out of the way when the highway is being graded, they are not apt to be broken off by the passing of an extra large load of hay or grain, and in snowdrift time they can be swung to the most accessible point of approach.

The support illustrated is made of a piece of 6-in. well casing 2 ft. long, with three circular notches in one end to serve as seats for the swinging arm. The casing is set in a concrete base with the bottom end open to allow for drainage. The arm is 1½-in. well pipe, flattened where the box is bolted on and screwed at the bottom into a discarded well cylinder, which is filled with concrete as a weight.—A. C.



The Morning Offering
will now be taken—

You may escape the collection ~ but not the need of **OZARKA SERVICE**

THE satisfaction you receive from your radio depends not on what it does once in a while—but night after night and month after month. Whether you grin or cuss depends on the service behind your radio.

Ozarka radio instruments are only sold by trained factory representatives, men who not only specialize in radio but sell and service Ozarkas only. 3,100 of these men, trained directly under Ozarka engineers constitute a service force, unequalled elsewhere in radio today.

When you buy a radio you'll compare appearance, tone, volume and selectivity by having various instruments set up in your own home—but that isn't enough—compare the service behind each one.

Any Ozarka factory representative will set up an Ozarka in your home—he will not even operate it himself, but depend for his sale on what you yourself do. If you, by your own operating, do not bring in the distance, the volume and tone, you expect a radio to give, then

do not buy the Ozarka. If you do buy it, you can rest assured, no matter what happens, a competent service man is at your call at all times. No Ozarka representative can sell Ozarka Instruments without giving Ozarka service. You are entitled to such service—demand it!

The Ozarka Representative knows every part, every wire of the Ozarka. In fact he completely assembles his own instruments. His training on installations, aerials, ground connections, operation and service comes directly under our own engineers who designed and perfected the Ozarka circuit.

That is why our book, "Ozarka Instruments No. 200," describing all models of Ozarka should be of particular interest to you. This book and the name of the Ozarka representative near you will be sent immediately at your request. Please give the name of your county.

We Have Openings for a Few More Ozarka Factory Representatives

OZARKA Incorporated, is now entering its 4th year. From a beginning with one engineer, one stenographer, one salesman—our present president, the Ozarka organization has grown to over 3100 people. There must be some good reason for this growth.

Ozarka instruments have made good—they have more than met competition. Ozarka representatives have made good not only because Ozarka instruments were right, but because they have been willing to learn what Ozarka engineers were willing and capable to teach them—Ozarka unusual salesmanship and Ozarka service.

There are still openings for the right men in this organization—men who believe in the future of radio—men who are tired of working for some one else—men who want a business of their own. Prove yourself by sales and willingness to learn and exclusive territory will be given you. The man we want has lived in his community for some time. He has the respect of his fellow men because he has never "put anything over" just to make money. He may not have much money, but he is not broke and is, at least, able to purchase one demonstrating instrument.

Check Coupon for FREE Selling Book

Radio offers a wonderful opportunity to men who are willing to start at the bottom and build. You need not know salesmanship, but will you learn what we will gladly teach you? You may not know radio, but we can and will teach you if you will do your part. With such knowledge and willingness to work, it doesn't seem possible that you cannot make good. Sign the coupon below, don't fail to give the name of your county. Better still write a letter, tell us about yourself and attach the coupon. If interested in our salesman's plan ask for "Ozarka Plan No. 120 R."



OZARKA

120 Austin Avenue R
Chicago, Illinois



INCORPORATED

120 Austin Avenue R
Chicago, Illinois

Gentlemen: Without obligation send book "Ozarka Instruments No. 120 R" and name of Ozarka representative.

Name.....

Address..... City.....

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Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

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Any Ozarka factory representative will set up an Ozarka in your home—he will not even operate it himself, but depend for his sale on what you yourself do. If you, by your own operating, do not bring in the distance, the volume and tone, you expect a radio to give, then

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The Ozarka Representative knows every part, every wire of the Ozarka. In fact he completely assembles his own instruments. His training on installations, aeriels, ground connections, operation and service comes directly under our own engineers who designed and perfected the Ozarka circuit.

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120 Austin Avenue R
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Name.....

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Gentlemen: I am greatly interested in the FREE book "The Ozarka Plan" whereby I can sell your radio instruments.

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When Children Ask

The plaintive request of the little child for a doll, a wagon or some simple toy is the most touching thing in the world.

Gladly you will deny yourself so that you can satisfy the want of the child.

And we would not have it otherwise. For childhood takes its pleasures with inexpensive toys—things that we should be able to give them.

The message we would like to impress is that you can have the things you need and give your children the things they would like. The way is easy.

It is only necessary to buy right. "Thrift is common sense applied to spending."

The Sears-Roebuck way is the sensible way. We guarantee to save you money.

Already we are serving nine million homes, or more than one-fourth of all the families in the United States. Sears, Roebuck and Co. have become the World's Largest Store because we lead in service, in quality and in saving. We buy in immense quantities and sell direct to you. We sell only quality merchandise, the kind that can be honestly guaranteed.

Our New Big Catalog for Fall and Winter is ready for you. It shows 35,000 opportunities to save on everything you need for the family, the home and the farm.

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If you haven't a copy of our New Big General Catalog, send for it today. This convenient coupon will bring you free our great Fall and Winter book, with its 35,000 bargains.

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We own and operate Radio Station W L S. Tune in on 344.6 meters.



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Only
\$4.90
for

A Selected Set Snap-on INTERCHANGEABLE SOCKET WRENCHES

With Which You Can Repair Your Ford In Garage Style

Be ready to fix it quickly in cases of emergency on the road—save repair bills—make your car run better and last longer. It is an easy matter to reach and turn the nuts and bolts throughout the Ford car with this remarkable Snap-On Set. There is a special chart which shows the inexperienced owner all of the most important repair jobs.

No need for you to be at the mercy of ordinary, inefficient tools when you can get the Genuine Snap-Ons for so little money. Snap-Ons will pay for themselves a hundred times over.



What Car Do You Drive?

There is a special Snap-On Set, equally as good for each different make of car. Any Snap-On dealer is an expert on the tool needs for your car. He can be of real service to you.

**Snap-On Wrench Company, Mfrs.,
Milwaukee**

Look for the name Snap-On on each handle and socket. It is not a genuine Snap-On without the name.

**Motor Tool Specialty Co.,
14 E. Jackson Blvd., CHICAGO**

Gentlemen:
Please send me full particulars about Snap-On Set for
.....car. (If interested in Master
Mechanic's Set, check here)

I buy tools from.....

Name.....

Address.....

The Home Workshop Preparing an End-Lap Joint

By Emanuel E. Ericson

Noted Manual-Training Authority



1 Lay one piece in the correct relative position on the other and mark the lower with the point of a knife. Turn the pieces over and mark the other piece.



2 Using your try-square and being guided by the marks you have just made, draw knife lines across one broad surface and about one-half the distance across each edge of each piece of wood.



3 Set your gauge for approximately one-half the thickness of the wood and mark both pieces, in each case marking from the upper surface or working face.



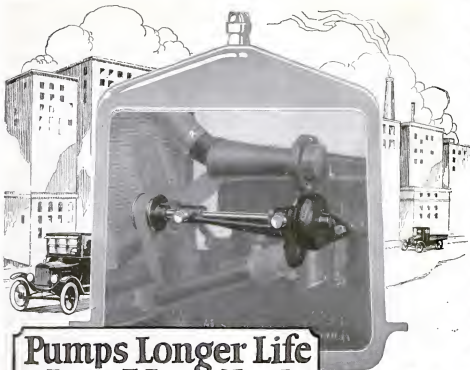
4 Cut on the gaged lines with a rip-saw, keeping on the side of the lines that is in the waste part of the wood.



5 The cross cuts necessary to remove the waste wood can be made most easily with a backsaw. A wooden bench hook—a board with a block screwed on top of one end and beneath the other—is convenient for holding the stock. The wood also can be held in the vise and cut with a fine hand-saw.



6 If carefully made, the joint will fit without chiseling and both sides will be even, provided the pieces are of the same thickness. The joint may be fastened with glue and screws, or nailed. It forms a simple yet strong connection.



Pumps Longer Life Into Your Ford

OVERHEATING junks more Fords than long service does. A boiling radiator is a danger signal. It means a power-sapped motor and thinned oil that leads to scored cylinders, burned-out bearings, and the scrap heap. Protect your sturdy little car with a Blackhawk Water Pump. It will keep your motor at the right heat for peak power and longest life.

The Blackhawk "Chief" outpumps all others because of its turbine-type impeller. Other features are its double bronze bearings with double grease lubricators, flanged drive pulley, and extra-husky construction.

A Blackhawk Pump is all-year protection. Ends boiling in summer, and prevents freezing in winter by briskly circulating the water and stopping evaporation of alcohol.

Your dealer can supply you with the "Chief" at \$7.50 (Western price \$8.00). Or write us direct.

BLACKHAWK MANUFACTURING COMPANY

(Formerly American Grinder Mfg. Co.)

DEPARTMENT L

MILWAUKEE, WIS.



Turbine Head

This exclusive Blackhawk turbine-type impeller delivers more water at all speeds.



The Scout

Here is the best pump at its price on the market. Second only to the "Chief" in pumping power and has many of its features. Only \$5.00 (Western list, \$5.50). Both pumps come complete with belt and horn bracket.



**Flanged
Crankshaft
Pulley**

Keeps your Ford fan belt always on the job. Interchangeable with old pulley. All steel and sturdy.

Only 75c

BLACKHAWK

This special insulation made to order for radio—

Now built into a line of low-loss parts



The first choice of thousands of successful set builders is Radion Panels—made of Radion, the insulating material built to order by our engineers for radio exclusively.

Now we announce new developments in radio parts made of this perfect insulation that practically reduces losses in reception to a minimum.

These parts have the wonderful Radion finish, smooth and highly polished. This finish eliminates those losses caused by moisture gathering on the surface of ordinary insulation, causing leakage paths. The high-resistant characteristics found only in Radion Panels also mark these new parts.

You can now get Radion Sockets, Radion Dials, the new Radion Loud Speaker Horn, Radion Tubing, Radion Bugging Post Strips, Insulators, etc. And, of course, Radion Panels (made in black and Mahogany) come cut in standard sizes for whatever set you wish to build. Ask your dealer to show you Radion Panels and the new Radion parts.

Send for Booklet "Building Your Own Set"

It gives wiring diagrams, front and rear views, shows new set with slanting panel, sets with the new Radion Built-in Horn, list of parts and directions for building popular circuits. Send coupon with 10 cents for your copy, American Hard Rubber Company, Dept. F-6, 11 Mercer St., New York City, Chicago Office: Conway Building, Pacific Coast Agent: Goodyear Rubber Co., San Francisco—Portland.



New No. 10 4-inch Radion Close-Tuning Dial built to conform to the fingers

RADION

The Supreme Insulation

AMERICAN HARD RUBBER COMPANY
Dept. F-6, 11 Mercer St., New York City

Please send me your booklet, "Building Your Own Set", for which I enclose 10 cents in stamps.

Name

Address

The Home Workshop

How to Repair and Adjust an Auto Clutch of the Single-Plate Type

MANY cars have what is commonly referred to as the single-plate clutch. This single plate is fastened on the forward end of the clutch or transmission drive shaft, power being transmitted to it from the flywheel. It rides between two friction surfaces or clutch facings.

While similar in action and banding to the multiple-disk clutch, the cure and adjustment of this clutch are not quite the same. The multiple-disk clutch in some instances is not adjustable and in other cases is adjustable by putting it under the arbor press and pressing the end driving plate down, after which a split collar is moved forward a notch. In other cases the multiple disk clutch is adjusted by taking up on three or more bolts, which compress the clutch springs.

The single-plate clutch is adjusted by loosening two setscrews to be found on the clutch cover, which is bolted to the flywheel. The two adjusting screws are easily recognized, since they are set in slots. When the screws have been loosened and the clutch has been disengaged by depressing the foot lever and the adjusting ring inside, the clutch is moved $\frac{1}{2}$ in. around to the right or clockwise by tapping either one of the setscrews. After moving them this amount, they are locked in position.

If the clutch previously has been adjusted until no further slot motion is possible, it will be found in most cases that new holes for the setscrews have appeared within the slots. A time finally comes, however, when it is no longer possible to adjust the clutch, and, unless the slipping is due to glazed friction rings, the job will have to be dismantled and new friction disks or rings installed.

MOUNTING RING AND ADJUSTING BOLT

FRICITION DISK SPLINED TO SHAFT

FRICITION RINGS

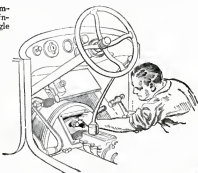
THRUST RING

RETRACTOR COLLAR

SLEEVE

COMPRESSION SPRING

Cutaway view of flywheel and single-plate clutch showing friction rings and adjusting bolts



It sometimes happens that the friction rings allow the clutch to grab or slip, yet are otherwise in good condition. In such cases it is well to wash out the clutch. Remove one of the adjusting screws and pour in $\frac{1}{2}$ pt. of kerosene. Replace the adjusting screw and start the motor. Allow the motor to run slowly from 10 to 15 minutes, working the clutch in and out as the motor runs.

Drive the car on a steep grade or blocks so as to raise the front of it higher than the rear. Turn the flywheel until the adjusting screw is on top, remove it and turn the hole down so that the oil may drain out. If possible, allow the car to rest in that position overnight.

If it is found that the clutch still grabs, a small amount of lubricating oil may be squirted on the plate and friction disks. Use just enough to moisten the friction disks. The latter method of treating a clutch may be used to relieve grabbing when it is not possible to wash it out thoroughly.

If it is found necessary to reline the clutch, which in this case is merely installing the new clutch friction disks—they are not fastened as are the multiple-disk clutch facings—the first step is pulling the transmission. The method of proceeding in this work was outlined in an article on relining clutch disks in the May issue of POPULAR SCIENCE MONTHLY (page 92).

When the transmission is pulled the clutch is left in the flywheel. To facilitate the work a block about $1\frac{1}{2}$ in. high and 4 in. long is used to block out the throw-out yoke. After the cap screws holding the clutch assembly to the flywheel have been removed, the clutch assembly will come away easily. Before removing it, however, prick punch some identification marks on the cover and flywheel to insure proper reassembly.

In all clutch disassembly and reassembly work the most difficult part is compressing the spring. Facilities at hand will determine the method to be used. The

(Continued on page 104)



*The covered wagon has gone;
like the old-fashioned charger
with the slow 2-ampere rate
it is obsolete!*
Buy nothing but an up-to-date 5-ampere charger!

The New Improved
**5 AMP. A & B
GOLD SEAL
HOMCHARGER**
\$19⁵⁰



Over 500,000 already in use

Get This Modern Fast Charger!

Better Because:—

New micrometer adjustment, hinged lid, and carrying handle.

No bulbs to buy or break.

Can be used anywhere—contains no acids or other harmful liquids to spill.

Approved by underwriters—trouble-proof, shock-proof and fireproof.

Beautiful cabinet in maroon and gold.

When you buy a charger don't let anybody sell you an obsolete, slow 2-ampere model.

The New Improved GOLD SEAL HOMCHARGER, with its full 5-ampere rate, charges your battery overnight! Does away with the long bothersome waits that were necessary when the slow inefficient chargers of last year were the best that radio offered.

And the New Improved GOLD SEAL HOMCHARGER charges both A and B batteries without additional equipment.

Be sure when you buy that you get a modern, fast charger, with a 5-ampere rate. To be *absolutely sure*, insist on the GOLD SEAL HOMCHARGER.

Free

Write for new edition of our instructive booklet on radio operation "The Secret of Distance and Volume in Radio."

The Kodel Radio Corporation
500 East Pearl Street Cincinnati, Ohio

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Owners of Kodel Broadcasting Station WKRC
on the Alamo Hotel. Send for program.



"ATKINS"

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Quicker, Easier
Metal Cutting!

YOU—whenever and wherever you cut metal—can save time and money by using genuine Atkins "Tungsten Alloy" Hack Saw Blades.

The Atkins Hack Saw Chart—free—tells the right Atkins blade for every metal cutting job, to save you time, money and material.

The name ATKINS on the blade means the highest grade "Tungsten Alloy" steels chosen by the great Atkins laboratories, tempered by the exclusive Atkins gas and oil process, "file tested" to prevent breakage and insure extra life and value.

Ask **YOUR** Hardware Dealer for genuine ATKINS "Tungsten Alloy AAA" Hack Saw Blades, "All Hard" or "Non-Breakable." We'll gladly send you the Atkins Hack Saw Chart and our valuable booklet "Atkins Saws In The Shop."

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Leading Manufacturers of
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Specialties and Machine
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INDIANAPOLIS, U. S. A.

ATKINS

TUNGSTEN ALLOY SAWS

The Home Workshop

A Simple Jigsaw Driven by Power

WHILE making a wooden pattern recently I found a jigsaw was indispensable. Only after having put it to use did I realize how much time such a machine will save in a small shop.

The jig frame or saw carrier is built of straight-grained hard wood bolted together. It can move up and down between vertical guides in the main frame. The main frame, which is designed to be attached to any convenient post, carries a table; this should be about 2 ft. square, supported on brackets exactly at right angles to the back board and, if necessary, reinforced with braces underneath, as shown in the photographs.

A short piece of shafting with a crank at one end and a pulley at the other runs in two bearings fastened at the lower end of the hack board.



The jigsaw as assembled (at left) and how it is used (at right)

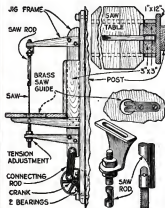
A short connecting rod connects the crank with the jig frame.

A small strip of brass is embedded in the table top to act as a guide for the saw blade. It prevents the saw from bending and breaking if the work is pushed against the blade too violently.

At the upper end of the jig frame is fastened a heavy piece of sheet metal cut and bent as shown in detail. The slot in this piece allows the saw blade to be adjusted so that it will be perpendicular with the table. To this metal bracket and to the lower arm of the jig frame are bolted threaded rods, each one being cut with a hacksaw, as shown, to receive and hold the end of the saw blade. An ordinary heavy coping-saw blade is used.

The table top should be sandpapered and varnished or oiled so that the work will slide freely, and the remainder of the machine should be painted. The pulley may be belted to a small electric motor or to any convenient source of power that will run the saw at a high speed.

—JONAS J. BYBERG.



Side view of machine, plan of saw table, and details of saw guide and fastenings

How to Steam or Boil Long Strips of Wood

HOW to steam or boil long strips of wood to get them into condition for bending is sometimes a puzzling problem. One simple solution is illustrated.

From a junkman obtain an old steam boiler tube or even a galvanized-iron rain-water conductor pipe, which will answer well enough if the seams and joints are water-tight. Close one end with a round wooden plug. Stand this end in a shallow hole in the ground and pack the earth around it firmly enough to hold it upright. Put a little water in the pipe if the strips are to be steamed; fill it, if they are to be boiled. Insert the wood, place a flat stone on top of the tube, and build a fire around the base. There will be no danger of an explosion, as a small amount of pressure will raise the stone on top. —JAMES E. NOBLE, Toronto, Can.



Steaming strips of wood that are to be bent

Balkite

Radio Power Units

the ideal power supply for any radio set

FOR THE "A" CIRCUIT

U. S. Patent
May 27, 1934

The Balkite Battery Charger

The most popular battery charger on the market. It can be used while the radio set is in operation. If the battery should be low you merely turn on the charger and operate the set. Charging rate 2.5 amperes. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price \$19.50

West of Rockies, \$20

Slightly higher in Canada

U. S. Patent
May 27, 1934

The Balkite Trickle Charger

Charges both 4 and 6 volt radio "A" batteries at about .5 amperes. Usable in 3 ways: (1) As a regular charger with a low capacity storage battery for sets now using dry cells. (2) With storage battery sets of few tubes. (3) With more current than used by 6 dry cell or 3 storage battery tubes, so that if used during operation it need be used at no other time. (4) As a "trickle" or continuous charger for storage battery sets of as many as 8 tubes. Size 5 1/4 in. long, 2 1/2 in. wide, 3 in. high. Operates from 110-120 AC 60 cycle current.

Low capacity batteries especially adapted for use with this charger are being offered by practically all leading battery manufacturers this fall.

Reputable manufacturers are also offering this fall for use with this charger special switches which turn on Balkite "B" and turn off the charger when you turn on your set. This takes the current supply for both "A" and "B" circuits automatic in operation.

Price \$10

West of Rockies, \$10.50

Slightly higher in Canada

Balkite Radio Power Units are the ideal power supply for any radio set. They simplify and improve radio reception. They reduce the amount of attention you must give your set. With their use your current supply is always exactly what is required for each circuit.

For the "A" circuit there are the Balkite Chargers. Because of its obvious advantages the Balkite Battery Charger is the most popular charger on the market. Entirely noiseless—it is the only charger commonly used while the set is in operation.

For set of smaller "A" current requirements—any dry cell set or sets of few storage battery tubes—there is the Balkite Trickle Charger. With a low capacity storage battery it enables owners of sets now using dry cells to make a most economical installation.

For the "B" circuit there is Balkite "B"—the outstanding development in radio. It eliminates "B" batteries entirely and supplies plate current from the light socket. It fits any set of 5 tubes or less. For sets of six tubes or more there is Balkite "B" II, the same popular model offered last year.

Noiseless—No bulbs—Permanent

All Balkite Radio Power Units are based on the same principle. All are entirely noiseless in operation. They have no moving parts, no bulbs, and nothing to adjust, break or get out of order. They cannot deteriorate through use or disuse—each is a permanent piece of equipment with nothing to replace. They require no other attention than the infrequent addition of water. They do not interfere with your set or your neighbor's. Their current consumption is remarkably low. They require no changes or additions to your set. They constitute the most advanced power equipment on the market, one that is economical, unfailing in operation, and eliminates the possibility of run-down batteries.

Manufactured by FANSTEEL PRODUCTS COMPANY, Inc.

North Chicago, Illinois

FANSTEEL

Balkite

Radio Power Units

FOR THE "B" CIRCUIT

U. S. Patent
May 27, 1934

Balkite "B"

Eliminates "B" batteries. Supplies plate current from the light socket. Operates with either storage battery or dry cell tubes. Keeps "B" circuit always operating at maximum efficiency, for with its use the plate current supply is never low. Requires no changes or additions to your set. No bulbs—nothing to replace. Requires no attention other than adding water about once a year.

A new model, designed to serve any set of 5 tubes or less. Size 8 1/2 in. long, 8 in. high, 3 1/2 in. deep. Occupies about same space as 45 volt dry "B" battery. Operates from 110-120 AC 60 cycle current.

Price \$35

Slightly higher in Canada

U. S. Patent
May 27, 1934

Balkite "B" II

The most outstanding development in Radio last season. Same as the new Balkite "B" but will fit any set including those of 10 tubes or more. Current capacity 40 milliamperes at 90 volts. Size 9 in. high, 6 1/2 in. wide, 7 1/2 in. deep. Operates from 110-120 AC 60 cycle current. Special model for 50 cycles.

Price \$55

Slightly higher in Canada

The Unipower, manufactured by the Gould Storage Battery Company, is equipped with a special Balkite Radio Power Unit.

BALKITE BATTERY CHARGER • BALKITE TRICKLE CHARGER • BALKITE "B" • BALKITE "B" II



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The Home Workshop

Easy Way to Build a Cornice

LIVING- and dining-rooms often are enhanced greatly by the addition of cove cornices. As ordinarily built, with the molding put up in single lengths, a high degree of skill is required to obtain good results, but by modifying the design to permit of splicing, the job may be simplified.

Figures given here are for the use of 8-in. cove molding made from rough stock $1\frac{1}{2}$ by 8 in., but the principles of construction are the same for narrower molding.

Measure out from the wall plates 11 in. and strike lines by chalking a string, stretching it tightly between the given points and twanging it against the ceiling. Strike other lines $2\frac{1}{2}$ in. from these running parallel to the ceiling joists, or about $8\frac{1}{2}$ in. from the wall plates, and carefully remove the plaster between the lines and the walls by cutting and chipping out with a cold chisel. With a compass saw cut off the lath to the line.

Now cut a pine "two by four" 6 in. longer than the width of the room and slip it up through the opening thus made. Nail the ends to the plates with the crown edge up and then nail it to all the loose lath ends. If the hacking joint in the corner can be removed, it will serve in place of a new piece. The purpose of this joint is to offer support for the upper member and cove of the cornice.

Plane straight one edge of four pieces of 1 by 3 in. S4S (surfaced four sides; that is, finished all over) stock of the wood chosen for the cornice and, of course, corresponding with the rest of the trim of the room. On the face side gage a line 1 in. from the jointed edges. Miter these pieces around the ceiling, keeping the



straight edges on the chalk lines. Use eightpenny finishing nails, and keep as many as possible behind the gaged mark, where the overlapping cove will cover. Scrape out any hammer marks that appear outside of the line.

By means of two sticks measure the length of the room 6 in. below the ceiling and cut pieces of cove molding $\frac{1}{2}$ in. shorter than the exact measurement. The upper edges may be cut back still farther to prevent them binding against the adjacent walls. Nail up the cove, tacking the upper edge to the 1 by 3 in. members on

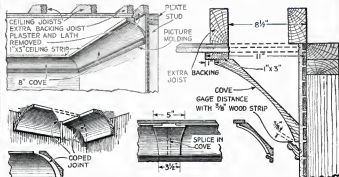


A neat cornice often greatly improves the appearance of a living- or dining-room.

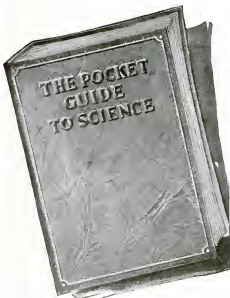
the ceiling and the lower edges to the stud- ding. This allows of pulling the nails for readjustment before the cove is nailed up solidly afterward. To find the studs, tap the walls lightly and locate one stud positively by driving nails through the plaster, where they will hide behind the cornice. Then measure points 16 in. apart.

Next build a miter box about 8 in. wide and 8 in. deep, by nailing strips of 1-in. stock on a bottom of 2-in. material,

(Continued on page 107)



How the cornice is applied; a cross section, showing the backing joist, the ceiling strip, the cove molding, and the picture molding; and details of a coped corner joint and a central splice



INTO THIS one brilliant book of 280 pages have been condensed the outstanding facts that scientists have discovered since Aristotle, the father of science, dissected a frog to see what made its heart beat.

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You promptly see the improvement register, by closer watch of the running.

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Veeder COUNTERS

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording



the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further more the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted

to no end of counting purposes, by regulating the throw of the lever. Price \$2.00. (Cut nearly full size.) Small Revolution Counter, also \$2.00.

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50 subject to discount. (Cut less than 1/2 size.) Set-Back Revolution Counter of similar model, \$10.00 (list).

Write us about that counting problem of yours—or see how it's solved in the 80-page Veeder booklet; copy free.

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The Home Workshop

New Polychrome Finishes

How to Decorate with Colored Bronze Powders Applied by Means of a Cheap Garden Spray

By William T. Weld

BY THE application of polychrome finishes that require perhaps less skill than any other method of finishing, you can beautify and rejuvenate many small pieces of furniture, picture frames, metal objects, lighting fixtures and other articles. Such a finish will cover up cracks, chipped or tarnished surfaces, and all sorts of blemishes.

The lower of the two accompanying illustrations shows a picture frame, two small electric lamps, a clock, a call bell, a piece from a dresser set, a tray and a vase that have been refinished in polychrome and are now quite attractive.

Polychrome means tinted with many colors; it is the finish now given to numerous floor and bridge lamps, mirror frames and novelties. The finish can be sprayed on with a garden or plant spray of the type having a glass container, usually to be purchased at seed stores for about 30 cents each.

Several sprays make for a little faster work, but only one need be bought providing that several extra containers are obtained. These cost about 10 cents each.

The bronze powders may be had in a large number of different colors, but gold, silver, blue, green, red, and statuary bronze will be found to produce about all the variety necessary. These powders are put up in 1-oz. packages and cost about 25 cents an ounce. Most paint shops carry them in stock.

Several small brushes will be needed. The bronzing liquid (of the varnish, not "hannan oil" type) costs about 50 cents for half a pint. A complete outfit should cost no more than a couple of dollars and with it you can do considerable work.

Perhaps there is a picture you wished to frame, but have not done so because of the cost. Almost every home has old framed pictures stored away in the attic or basement. These are often in pretty good shape and need only a little repair work to make them quite presentable.

First remove the old picture and the glass from the frame and wash the frame thoroughly with strong soap and water. Use an old toothbrush to clean around the corners and the raised places, if there are any. Buy 10 cents' worth of dental plaster of Paris at any drug-store. Mix about a teaspoonful with a little water until a stiff paste is formed. After wetting the surface upon which this is to be applied, take a small knife and build

up each chipped place until it matches the rest of the surface. If the plaster becomes hard or sets before you have finished, you may cut or scrape it until the desired shape is obtained.

After all defects have been remedied in this manner, go over the patched places with steel wool or fine sandpaper. Now dust off the entire surface and wipe clean with a cloth moistened with turpentine or benzine. Give each patch a coat or two of the bronzing liquid or shellac or varnish. You now are ready to apply the colored bronzes.

If you want only one color, simply mix enough of the powder with the liquid to make it about like thin paint. The proportion of 1/4 oz. (a level teaspoonful) of

powder to 8 table-spoonfuls of liquid will be found quite satisfactory. After stirring this thoroughly it may be brushed on the frame.



extra containers are obtained. These cost about 10 cents each.



Spraying the base of an electric lamp and a group of objects finished in polychrome

To produce the mottled polychrome effect, however, the spray should be used. Mix your color in the same proportions and place the frame on an old paper or stand it on edge and hang a paper behind it.

Your own taste will have to guide you in planning your color scheme. If you wish certain raised portions to be of one color and the sunken portions of another, simply spray the entire surface with the color you desire the raised portion to be. Let this dry for about 30 minutes and then apply the second color. While this is still wet, take a pad made from several layers of cheesecloth and wipe off the entire surface. This will remove the fresh color from the raised surface and at the same time expose your first color.

For a mottled effect spray on one color

(Continued on page 106)

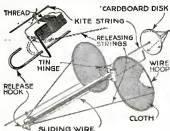
The Home Workshop

Unique "Butterfly" Travels up and down Kite String

KITE-FLIERS will find amusement in constructing this novel "butterfly." It is carried up a kite string by the wind to a point near the kite where a cardboard disk is located. Upon striking the disk the wings of the butterfly collapse and it slides to the ground.

The body, of light wood about $\frac{1}{4}$ in. square and $\frac{1}{2}$ in. long, is mortised to a block $\frac{1}{4}$ in. thick and $\frac{1}{2}$ in. square. The wire frame for each wing, which is about 3 in. in diameter, is fastened to the block by means of a piece of light tin secured by cigar-box nails, so that it will fold back easily. The wings are covered with cloth and painted with thick starch.

At the end of the body a bent piece of tin with two holes in it is fastened by wrapping



When the butterfly strikes the cardboard disk, the wings collapse and it slides back to earth

with thread and smearing with glue. A hole is drilled in the wooden wing block to correspond to the lower hole in this tin clip. A piece of stiff wire runs through these holes, one end terminating in a book as shown. The other end projects about 10 in. beyond the block and ends in a right-angle bend. This is the end that goes toward the kite.

The kite string passes through a small screw eye fastened at each end of the body. A string tied to the outside of each wing ends in a loop. When the butterfly is set for a flight upward, this loop is caught by the hook on the straight wire. The upward flight of the butterfly is stopped by a heavy cardboard disk, 3 in. in diameter, which is fastened on the kite string near the kite and braced with stiff wires.—EDWIN G. GETTINS.

Metal Corner Pieces Conceal Cracks in Picture Frames

LARGE picture frames often become unsightly because the mitered joints crack open. If the frame is not mitered too elaborately, the joints can be concealed with ornamental corner pieces cut from No. 26 gage sheet brass or copper. These are fastened in place by means of small escutcheon pins. The metal may be colored or left bright, as desired.—W. J. E.



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that wins men by its fairness

Don't buy yet—wait till the 10-day tube we send you proves its case

GENTLEMEN:

Palmolive Shaving Cream is today the leader in its field.

Yet we urge men not to buy it before they try it.

Our whole case rests on a 10-day tube that we send, free, for a test.

On that basis we have won the world to this new creation.

Men by the millions are flocking to it. Its success is a business sensation.

Give us ONE chance

We realize you are probably wedded to another shaving cream.

But, as expert soap-makers (we make Palmolive Soap, you know, the world's leading toilet soap), we know a fair comparison 80 times in 100 will win you.

Palmolive Shaving Cream is a unique creation. There is no other like it.

It embodies the four great essentials 1000 men expressed as their supreme desires in a shaving cream—plus a fifth, strong bubbles, the most important of all.

60 years of soap and skin study stand behind it.

130 formulas were tested and discarded before the right one came.

10 days of its delights, we believe, will win you to our side.

Now as a courtesy to us, will you mail the coupon and accept those 10 shaves free?

5 New Joys

These you'll find—these new shaving joys, these comforts unknown before:

- 1 Multiplies itself in rather 250 times.
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- 4 Strong bubbles hold the hairs erect for cutting.
- 5 Palm and olive oils bring one fine after-effects.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream.

PALMOLIVE SHAVING CREAM

2953

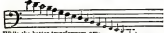
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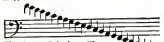
Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.



What becomes of the bass notes in your set?



While the better transformers usually copy evenly over the entire upper and middle ranges of the musical scale, from about 40 cycles downward there is a pronounced loss of amplification. Poorer transformers begin to drop off in amplification even higher on the scale with the result that lowest notes disappear entirely.



There is no variation in amplification over the entire range of musical frequencies with Thordarson Autoformers. No note is too low—no note is too high to be lost by the Autoformer. In addition there are three other advantages.

Four Great Improvements

Full amplification of those bass notes hitherto largely "lost"! Greater clarity on all signals! Improved reception of distant programs! Better volume control!

These are the four advantages achieved by this latest Thordarson development—the Autoformer. Thordarson has succeeded in utilizing, for the benefit of your radio set, the same principle used in the line amplifiers adopted by the more recent high-powered broadcasting stations. The excellent quality of these stations (due to perfect amplification) offers conclusive proof of Autoformer effectiveness.

Unconditionally Guaranteed

THORDARSON

Autoformer

Trade-Mark Registered

All Frequency Amplifier

Autoformer amplification is for those who seek the finest reproduction of programs to be had. It may be used with any set in place of the regular audio transformer hook-up.

Full directions, with diagrams, for building a Thordarson Autoformer Amplifier are supplied with each instrument. Or

Write for the Autoformer Hook-up Bulletin—Just Send

THORDARSON ELECTRIC MANUFACTURING CO.
WHEELING, OHIO AND LARCHMONT, N.Y. TRANSFORMER MAKERS
Chicago, U.S.A.



The Home Workshop

Neat Desk or Table Stand for Large Dictionary



CROSS-WORD puzzles caused the unabridged dictionary to become better appreciated as a reference book for home use. Its main drawback is its cumbersome size, but that can be minimized by constructing the table stand illustrated. The dictionary then may be consulted without leaving the desk or table.—J. P

New Polychrome Finishes

(Continued from page 104)

and then another until the desired result is obtained. Gold or silver first, then blue, green, and red is a good order.

In using the sprays and bronzing liquid in this manner you do not need to wait until each separate color is dry. The only precaution to take is to avoid too much liquid at one time, otherwise the surface will become streaked.

You will be delighted with the way the spray of one color blends with another. The best part of applying this kind of finish is that you can't spoil it. Should you get on too much of any one color, simply tone it down by spraying on a little gold or silver.

If you have several small articles of one kind to finish, place them close together while spraying.

If you plan to do considerable work, it will be found economical to buy some shellac or ordinary varnish in place of the bronzing liquid. The varnish should be thinned with turpentine and the shellac, if necessary, with alcohol.

If you desire a rough surface similar to that on much of the commercial polychrome work, a very simple method is as follows: With a brush apply a very heavy coat of what is known as paste wood filler. Do this to the surfaces you want left rough and let it dry for about 30 minutes. Tap this lightly with a stiff brush until it is quite rough. Let it dry for several days, then sandpaper it very lightly to remove the sharp tips. Let this harden for a week, apply a coat of shellac or varnish, then spray as desired.

Household articles on which this colored bronze finish is appropriate are

electric fixtures, gas fixtures, shelf brackets, wall registers, door-hells, open plumbing, radiators, spice cans, bread and cake boxes, candle-sticks, mirror frames, metal waste baskets, and book racks.

Mats of Corn Husks

(Continued from page 84)

braids back and forth instead of around. Be sure all the husk ends are on the same side, which is to be the top. They should not be cut off except sufficiently to reduce them all to the same length. The resulting mat will last almost a lifetime, if dried out whenever it gets wet.

While these look well in their natural color, they are more attractive if colored. This can be done either before or after making. Pretty effects may be obtained by using several colors alternately when braiding the strands. To color husks, let them stand in ordinary clothes dye for six hours or more.

The husks can be made almost pure white by washing them in good strong soap and water in a washing machine. If this is done before dyeing, the colors will be brighter. Be sure, however, to wash out all the soap, if you intend using dyes.

Rugs, mats, and table mats can be made by the same method, except that the husks should be used singly or split into small shreds. All the ends in this case should be cut off when dry.

A sewing basket may be made by winding tightly made braids, with all the ends cut off, around a form of round or square sticks. Sew the braid together as the work progresses. The turns go alternately inside and outside the sticks, as shown. The lid is stiffened with heavy wire reinforcement and has a tassel or ring in the center to serve as a handle. These baskets look best if varnished. —RALPH ALLWINE, Shelby, Ohio.

Improving Cheap Jewelry

ALTHOUGH heavily gold- or silver-plated in front, some grades of jewelry soon wear down to the brass base on the back. Wrist watches, rings, and other pieces of this kind are apt to leave a black deposit on the skin. The tarnish

may be prevented, however, by coating the



Coating back of wrist watch and "silvering" a ring in old "hypo"



back with transparent shellac or varnish.

Cheap brass jewelry can be improved in appearance and wearing qualities by suspending it overnight in old, much used "hypo" solution, obtained from your local photographer. The jewelry becomes coated with the silver dissolved in the hypo from photo films and papers.—K. B. M.

The Home Workshop

Easy Way to Build a Cornice

(Continued from page 102)

and sawing through both sides at angles of 45 degrees. Cut four pieces of cove molding 8 in. longer than half the remaining sides of the room, and miter hack one end of each to get the profile of the curve as a guide for cutting.

Cut the curve with a coping-saw held in a plane parallel with the top of the molding; or a narrow, fine-toothed cross-cut saw may be used. With a sharp chisel trim the cut toward the back to make certain that only the surface edges will bear against the mating mold that already is up.

HOLD one piece in position against the ceiling, tacking if necessary to remove kinks, to test the fit with the other cove. If the joint is poor, scribe with a pair of dividers and cut again, or trim the high points with a block plane. When a first-class fit is attained, tack in position and mark the other end at the center of the wall.

Fit a length to the opposite molding in the same way and nail up solidly. Finish the remaining wall in the same way.

Cut two blocks of 2 by 6 in. stock 8 in. long. Taper these from a width of 5 in. on one end to 3½ in. on the other, curving the edge inward for the sake of neatness. Cut a cardboard pattern to fit the curve of the cove, and use it to lay off the edges by which the back of the block may be chiseled. After careful fitting, curve the front face or, if desired, carve a leaf on each for further ornamentation, and nail up with sixpenny finishing nails. Fit similar blocks in the centers of the side coves.

Put up the picture molding in four pieces, since the joints are easier made and the lengths may be sprung into place, exerting great pressure at the joints, sufficient to close them in spite of small irregularities. As a gage, hold a ¾-in.-thick strip of wood between the top of the mold and the bottom of the cove, so that space will be provided for picture hooks.

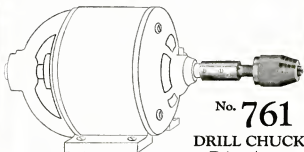
IF THE builder feels disposed to put up full-length coves, he should leave the ends of the first pieces a trifle loose, so that pressure from the next piece will spring it to shape against its joint curve. It is also well with such large moldings to put up each piece in succession, so that only one joint is cut on the end of all but the last piece, allowing of a little "give and take" for fitting. Or, the pieces may be put up full length without special care being taken with the corner joints, these being covered with ornamental blocks.

If lead wires in loom are tapped from the electric wires and run behind the cove, suitable light fixtures can be put in the corners, hiding the joints and aiding the illumination of the room. In the latter case, however, city ordinances probably will require official inspection.—E. M. L.

"HOW to Cover Cracked Plaster with Wallboard," by Edwin M. Love, is one of many helpful articles for home owners scheduled for the October Home Workshop.

Attachments that give your motor more uses

WHY not equip your motor for drilling, grinding, polishing, and buffing? The Goodell-Pratt small motor attachments make it easy. Just fit any of them on the shaft and the motor is ready to go to work.



No. 761

DRILL CHUCK

Price, \$3.00

No. 757 Drill Chuck: Fits motors with ½-inch shaft. Similar to No. 761, but smaller. Holds round shank drills from 0 to 5/32 inch. Length 3½ inches. Price, \$2.00.

Fits motors with ½-inch shaft. Enables you to drill in iron or steel. Three hardened steel jaws hold round shank drills from 0 to ¾ inch in diameter. Length over all, 4¼ inches.



No. 762



No. 759

Saw Arbor and Buffing Spindle: Has a shank that can be fitted on a ½-inch shaft. Arbor takes grinding, polishing, and buffing wheels, wire brushes, etc., with ½-inch hole. Flanges open ¾ inch. The tapered spindle on the end of the arbor has a deep, clean thread for handling the great variety of wood-centered wheels. Length, 5½ inches. Price, \$3.00.

Buffing Spindles: Have a clean, deep, tapered thread for holding wood-centered wheels. They are made with both right and left hand threads. The shank is made to fit a ¾-inch shaft. Length, 3¼ inches.

No. 759. Spindle with R. H. threads, Price, \$1.00.

No. 760. Spindle with L. H. threads, Price, \$1.00.

Write for Catalog No. 15

See all the other of the famous 1500 Good Tools that Goodell-Pratt make. All are shown in the big general catalog. Write for a copy. It's free.

Saw Arbor No. 758: Similar to No. 762 above, but smaller and without the tapered spindle. The shank fits ½-inch shaft and the arbor will take saws or wheels with a ¾-inch hole. Opening between flanges, ¾ inch. Length over all, 3¼ inches. Price, \$1.50.

GOODELL-PRATT COMPANY, GREENFIELD, MASS., U. S. A.

Makers of Mr. Punch

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1500 GOOD TOOLS

Can one tobacco satisfy a man with 45 pipes?

You might imagine that the law of averages would require a man with 45 pipes to smoke a variety of tobaccos.

Evidently, it doesn't work that way, for here is a pipe connoisseur who after vainly trying every tobacco his tobaccoist could mention, finally got around to Edgeworth. The result is, his humidor is now "Edgeworthized."

Mr. Sonnenhlick makes application for a life membership in the Edgeworth Club. All in favor say "Aye."

But first read his letter:

Larus & Bro., Co.
Richmond, Va.
Gentlemen:

When a man has 45 pipes he certainly is up against it for an all-around tobacco. But first, about my pipes. There are 2 Dunstons, 6 Comys, 4 B&B's, 4 Kaywoodies, 2 Petersons, 2 GBD's and the usual meerschaum, calabash, cornco, etc. Some were sweet from the start, others remained obdurate and bitter despite the fact that I used every American brand and every English brand I could get or my tobaccoist could mention. Fancy prices! Hang the price, I wanted pipe satisfaction. The brass, cornco, etc., the mixtures I made failed because the tobacco varied.

I saw the ads written by Edgeworth smokers, but they sounded too good to be true. I didn't try Edgeworth in despair, but just to see how less bad it might be. Well, it's so good that you know that my office humidor has been Edgeworthized. Now my good pipes taste better and my bad pipes taste good.

If you've got a life membership open put the down. It's the King Bee of tobaccos and I think in a qualified judge.

Respectfully yours,
Ira J. Sonnenhlick.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10-1 South 21st Street, Richmond, Va.



Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dollar carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

Canvas Strip Used as Campers' Shoot-the-Chute



THIS is perhaps the cheapest, lightest, and most easily transported shoot-the-chute that the camper can make—simply a length of heavy canvas about 2 ft. wide provided with a grommet in each corner. One end is attached to a tree limb and the other end to two posts, or anchored to the bottom by means of heavy rocks.

Adapting a Die to Thread Hard Rubber and Fiber

IN RADIO and other work it is difficult to cut clean threads with an ordinary die on rods of hard rubber, fiber, and similar materials. The crumbling of the threads can be overcome by modifying the die as shown in the illustration.

First run a thread on a rod of brass or soft iron and then file three flats on it to make it nearly triangular in cross section. This is to serve temporarily as a tap.

Plug the clearance holes in the die with the same material that is to be threaded and use the improvised tap to clear out the die. This gives the die the appearance of a plain threaded hole, except for the difference in color between the filling material and the steel. The clearance-hole plugs serve to support the threads as they are cut.—W. J. E.

Drill Press Cheaply Built

(Continued from page 82)

should be machined down to fit into the hall bearing selected for this point. In order to machine this gear, it must be annealed. This may be done by heating to a cherry red and holding it at that temperature for a time, after which it is allowed to cool very slowly. It is likely that the gear will need to be hushed and a new key provided.

The gear W carries a fixed key that

allows the keyway in A to slide freely over it. The hall bearing that carries W is larger than the others and requires a larger piece of tubing to mount it. G' is the same diameter as G'. It has feet welded to it to support it on D. The shaft A is made from a propeller shaft and the shaft B from an axle shaft.

The hall bearings that support the shaft B are mounted in steel blocks QQ. These are turned in the lathe to fit into the pipes FF, which are split and provided with bolts for clamping.

The author purposely has refrained from going into minute detail with reference to part sizes. A great deal of satisfaction comes to the builder of a piece of equipment of this nature in knowing that he has incorporated some of his own ideas. It is a good plan to gather together every possible part that might work into a projected machine and see how they will lend themselves to the plan. The most intricate parts should receive first consideration. Each part used will be found to have a definite influence on other parts and on the design of the entire machine.

The chuck provided for this machine is of the conventional design. It is driven by a 1/2-horsepower motor having a speed of 1800 revolutions a minute and carrying a 3-in. pulley. This gives a serviceable range of speeds.

How to Repair a Clutch

(Continued from page 94)

garage or arbor press is the usual method, but the ingenious owner-driver can improvise a jack, vise, or pry arrangement that will do the work.

Where equipment is limited for handling this particular job, some mechanics use a couple of long studs threaded to fit the flywheel rim and thus by assembling the clutch in the flywheel they are able to draw the cover plate down and at the same time compress the spring.—R.F.K.

Light Wire Holder Clamps Ink Bottle on Drafting Table



ALTHOUGH various ink-bottle holders are at the disposal of a draftsman, I have found the device illustrated to be especially satisfactory. It is made of a single piece of spring brass wire bent as shown. The loop passes over the neck of the bottle and rests snugly against the shoulder.—A. C. SELETSKY.

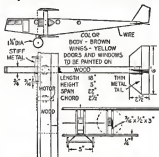
The Home Workshop

Toy Aerial Express Cruiser Made with a Pocket-Knife



BUILT for carrying many passengers, an aerial express cruiser is a giant airplane. This toy model of one is, therefore, larger than the three airplane models previously described in this series, but it is on the same scale and in correct proportion to them.

The body is whittled from a piece of clear white pine or other soft wood $\frac{1}{4}$ by 2 by 17 in. The upper wing is $\frac{1}{4}$ by $2\frac{1}{2}$ by 22 in.; the lower, $\frac{1}{4}$ by $2\frac{1}{2}$ by 16 in. Each of the two motors is whittled from a wooden block $\frac{1}{4}$ by 1 by 2 in. and is supported by two strips $3/16$ by $\frac{1}{2}$ by 3 in. as shown. The distance between the body and the motor on each side is 3 in.



Side, top, and front views of the fourth in a series of realistic toy airplanes

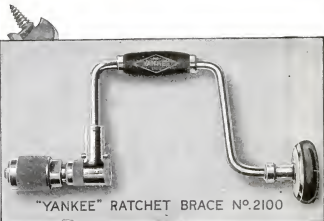
It will be noted that the two small strips that support each motor also brace the upper wing, and two similar strips are used to attach the center of the upper wing to the body.

The landing-gear, tail members, and propeller, as in preceding models, are made of thin sheet metal. The wheels are $3/16$ by $1\frac{1}{4}$ in. wooden disks.

The next toy in this series will be a translucent air-liner.—D. W. C.

Adjustable Float for Fishing

BY BEING free to slide on the line, this adjustable float allows the fisherman to reel in his line completely when through fishing. It is merely a large cork with a $\frac{1}{4}$ -in. hole through the center, hushed at each end with a large glass bead. The fish-line runs through the beads. When you are ready to cast, simply push a small wire paper clip over the line at about the point at which you wish the float to remain.—L. B. R.



Any bit stays tight in this chuck

Here, at last, is an efficient bit-brace chuck. Slip into it any shape bit (round, square, any taper), and the bit is held in a vise-like grip.

Saves time by centering bits accurately, and locking and releasing them instantly. Ball-bearings give chuck the easy action in your hand.

With it you can do every kind of boring job within the scope of a bit-brace.

"YANKEE" Ratchet Bit-Brace No. 2100

A touch on the easy-acting Ratchet Shifter gives you a powerful ratchet that works without needing a hand to prevent chuck from turning back. Ratchet is bronze-encased against dust and moisture.

"Yankee" introduces for the first time hard rubber brace handles. Won't warp, shrink, bend or crack. A patented method prevents excessive play in sweep handle.

Finished beautifully in keeping with its perfect mechanism. See it today in the "Yankee" Counter Demonstrator, at your dealer's.

Made in four sizes—8, 10, 12, and 14-inch. Chuck holds rounds up to $\frac{1}{2}$ -inch; 14-inch Brace holds up to $\frac{1}{2}$ -inch square.

Dealers everywhere sell "Yankee" Tools

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The Home Workshop

Fitting up an Unfinished Attic

(Continued from page 79)

In the same way level another joint near the center of the room, having first leveled one end with the end of the first. Intermediate joists then may be lined by spanning the first two with the straight-edge, as in Fig. 2. Unless the joists all are planed to straight-edges, or have equal amounts of crown, it is useless to attempt to obtain levels from the center of any joist. It is extremely important to bring all joint ends into the same plane.

To prevent canting of the floor joists, fit pieces of 2 by 10 in. stock between all bearing ends. They may be placed in a direct line or staggered (Fig. 2). If a span is 8 ft. or more, a center course of herring-bone bridging is required. The length of each piece from the obtuse angle, or "short point" of one end to the acute angle or "long point" of the other is the hypotenuse of a right triangle with a base equal to the distance between the joists and the side $7\frac{1}{4}$ in., while the angle cut is, of course, an acute angle of that triangle. If the joists are spaced evenly, one piece should be a pattern for all.

Strike a chalk line to guide by, and nail the bottom ends of the pieces as illustrated at the bottom of Fig. 2. Do not nail the upper ends at this stage.

Nothing but vertically grained flooring should be used, and preferably the lengths should reach across all joists, eliminating

is evidenced by the surface being lower than its mates, and its stubborn refusal to nail up closely to the first board.

Lay the first board to a straight line, nailing through from the face, as the partition plate covers it. Blind nail the following boards, using eighteenpenny wire box nails, and working from one end to the other. If firm tapping with the side of the hammer and subsequent nailing do



Fig. 3. The floor beams are laid temporarily across the ceiling joists to form a platform

not force a board into place, use a scrap of flooring as a buffer, striking heavy blows with the hammer or a hand ax. All splinters on the tongue should be removed carefully. To avoid loose and creaking boards, drive the nails firmly home, and if this cannot be done without hammer marking, use a nail set for the last two or three. Sometimes a hammer dent can be taken out by moistening the bruised spot, thus swelling the crushed fibers. The outer ends of the flooring need not be smoothly cut.

When the center of the room is reached, the joists then being brought into alignment, nail the upper ends of the bridging. The flooring then may be completed.

If it is desired to surface the floor, it may be scraped smooth at this time provided it is covered immediately to prevent marring during later construction. The advantage in scraping it at this stage is the absence of walls, which makes it easier to smooth the extreme margins.

How to continue from this point will be told in the second article of the series in next month's POPULAR SCIENCE MONTHLY.

Novel Violin Bridge

SINCE adding a weight such as a mute to the bridge of a violin softens or deadens the tone, it occurred to me that removing weight would have the opposite effect. A violin bridge, therefore, was

joists. If joints are necessary, make them on the joists, cutting with a fine-toothed saw and beveling under slightly to insure a tight fit on top. Take care, if the flooring is surfaced on the under side, not to nail a board upside down. The right side, as shown in Fig. 2, is farther from the tongue and groove than is the wrong side. Also, the upper lips are longer than the lower, that the joints between boards may come tight on top. A board upside down



Violin bridge

the weight. One-third the original bridge was removed. The result was a noticeable increase and improvement in the tone.—J. H. DOWNIE.

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money



HOW often have you wished for a water-resisting cement that would join glass, metal, and wood, or a combination of these substances, tightly and firmly and would not give way under hard usage? Such a cement is described below.

When fastened together by it, articles can be placed in water for months without any injurious effects. Aquariums can be cemented with it, and the glass sides will not require any outside support. It will hold glass by the edges alone and at the same time resist the action of the water. Broken glass or porcelain can be mended with it, metals can be joined together, and metal can be attached to wood. This is of special value in resetting tool handles.

The cement must be prepared in either a porcelain dish or in a beaker that can be heated. Make only a small quantity at

Pouring creosote into beaker (below) and adding shellac to hot creosote while stirring (at right)



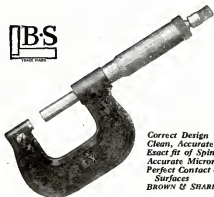
one time, for very little is required to do considerable work.

Creosote and dry flake shellac are required. Just pour enough creosote into the beaker to cover the bottom of the dish. Heat over a small flame such as an alcohol lamp and add the shellac gradually while stirring the mixture. Add enough shellac to the hot creosote to make a very thick, syrupy solution. Allow this to cool, when it should be so hard that it is difficult to make a deep impression in it with a fingernail. The adhesive power will be slightly greater by having the mixture still thicker and harder, but then it is slightly more difficult to work with.

In order to use this cement the parts to be joined must be heated to a temperature sufficient to melt the mixture. The cement is applied hot by means of the stirring rod used in mixing the chemicals.

The hot cement can be applied to the parts to be mended, even if they are only slightly warm, but then the joints must be heated over an alcohol flame so that the cement runs freely and enters and spreads uniformly. The parts to be mended will not be tight unless the joints are heated sufficiently to melt the mixture. The thinnest film, if properly applied, will hold as well or better than a thick blob of the cement that will not adhere to the mended parts.

B.S.
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Perfect Contact of Measuring
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—Remember, the "Rex" is a Brown & Sharpe Micrometer of the Brown & Sharpe Standard of Accuracy.

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POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

Better Shop Methods

(Continued from page 84)

Kinks that Make My Work Easier

By E. C. Fellows

MY SHOP work is made easier by a few inexpensive machine accessories and tools and some simple shortcuts. Four examples are given below, not so much because they are out of the ordinary as because they will suggest similar and perhaps better expedients.

Time is saved on shaper work by using a set of hold-downs made as shown in Fig. 1. On one side of a piece of angle iron, just double the length of the vise jaws, I planed an angle of about $1\frac{1}{2}$ deg. as indicated. The angle iron then was cut in half to make a pair of hold-downs. It is better to have the side next the vise jaws shorter than the other side.

To aid in clamping tapered work in the shaper vise, I prepared a swivel block to use on one side of the taper, using it in connection with the hold-downs. The swivel blocks are made of cold rolled or machinery steel. One block has a circular projection that fits into a corresponding seat in the opposing block. The blocks have a $\frac{3}{4}$ - or 1-in. space between their inner parallel faces. The dimensions of the blocks and the hold-downs may be varied.

One day I needed a few thumb-screws in a hurry and, as there was none in stock of the right size, decided to make them. The method I followed was not only quick and cheap, but saved the time that the work would have been delayed while awaiting the arrival of purchased screws of the correct size. An ordinary washer and a filister-head machine screw were used as shown in Fig. 2 to make each thumb-screw. The washer was cut in half and soldered into the slot; the projecting ears then were filed round. This made a thumb-screw of good appearance that served the purpose quite as well as a commercial thumb-screw. In the figure are shown variations of this idea to suit different styles of machine screws and bolts.

Figure 3 illustrates a tool that saves much time in centering work in a lathe. It is a holder for a combination drill and countersink of the conventional kind. The holder is made from a piece of cold-rolled or machinery steel $1\frac{1}{2}$ in. in diameter, with a hole drilled and reamed in both ends. The holes are made to accommodate two sizes of drills corresponding to the sizes in general use. A setscrew is used to lock the drill in place. In drilling the holes it is important that

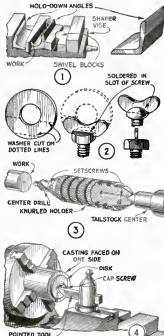
they should be in line with each other and true to size. The ends of the holes are chamfered slightly to fit the lathe center and the outside is knurled to provide a hand grip on the tool while it is in use.

Turning and finishing a thin disk or washer in a lathe is not always an easy task and some machinists make a poor job of it or spoil a few before they turn out a good one. When I have a job of this kind, I proceed as follows: If the disk is made of sheet steel or iron, which is the usual and by far the most economical way, I first face one side of it. Then I find a round casting of suitable diameter and chuck it in the lathe as seen in Fig. 4. Next, I face off one side and drill and tap a hole in the center for a bolt or cap screw. I then clamp the disk on the casting by means of a cap screw and

small washer. The two finished faces abut each other. By taking light cuts with a sharp pointed tool, I reduce the metal to the right thickness and then finish the outside diameter.

If the inside diameter is to be finished to a specified size, the disk can be held to the casting with three small screws on the outside. Remove the central screw after tightening up the outside screws and proceed to turn the inside diameter. Remove the sharp edges with a file, and the piece is finished.

By this method I have made washers $1/64$ in. thick that were true and parallel in thickness.



Hold-downs and a center drill holder; methods of making thumb-screws and thin washers

Better Shop Methods

Chasing a Difficult Thread

(Continued from page 85)

in diameter that had come in to have some missing teeth replaced. He nodded approval when he saw 1-in. studs being screwed in with a 2-ft. pipe-wrench.

"I am glad to see that you are getting them in tight enough to stay," he said.

Laten, the machinist, kept on with his work. Old Bill wandered on. When he came back a few minutes later, the last stud had been screwed in and sawed off. The machinist had begun to chip them.

As Old Bill approached he was chalking the ends of the studs and, with dividers set from good teeth, spacing off the ends of the teeth, always spacing from a good tooth.

"That is the best way to make them accurate, Boh," Old Bill said. "Get a thin piece of sheet iron and make a template so that you can get the curves of the teeth about right. Hold the sheet on the side of some of the good teeth and scribe the outline so that you can cut it to the shape of the teeth. There is one other thing that you can do:

"Clean out several of the good teeth and cast a hahhitt imprint of them that you can use to try on your studs to be sure there are no high spots to pound every time the wheel goes over. Clamp a board on each side of the teeth and fill up about three teeth with hahhitt, and have a web to connect these teeth. Then you can use these hahhitt teeth to 'spot in' the new teeth."

"I had been wondering how I was going to get them just right," Laten said.

"You will not be able to get them just right," Old Bill replied; "but you can get them pretty nearly so by using all three of these methods."

OLD BILL could tell by the group gathered about the big radial that the thread-cutting job was about to commence. He went over to watch the proceedings.

"I thought I would bore the hole round with a flat tool before cutting the thread," the machinist explained.

"That is a good idea; it will give you a better chance to set your threading tool."

The drill had a tapping attachment, so the cutting of the thread was not so hard as it might seem. The thread tool was set for a light cut. It was run down slowly the first time. Old Bill held out a hand.

"Now, in bringing it up again, be careful that you do not spoil the thread you have started," he said. "Do not let the screw have to push up the whole weight of the spindle, but help it out with the feed lever."

About four cuts down produced a satisfactory thread. The welder's helper had already brought in the seat that had been built up, and one of the machinists had taken it to a lathe to turn it off and chase the new thread.

Old Bill felt the depression that sometimes comes from a hard day's plugging about the shop rise from his shoulders. He knew that the pump would be delivered on time!

A smile illumined his face as he returned to the magazine.

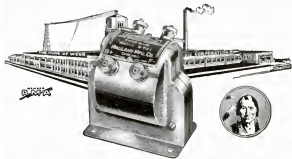
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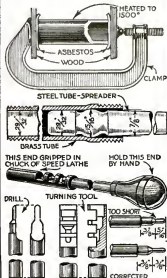
Unusual Ways of Reclaiming Spoiled Machine-Shop Work

By Charles Kugler



SPOILED work in machine-shops runs into millions of dollars annually, yet only a small percentage of it is reclaimed. Few are the shops that do not have to contend with this problem. The mechanic who never spoiled a job is rare indeed. Between the planning and the completion of a job, no matter how skilled the individual worker may be, there is always a chance for misunderstanding and errors.

Doctoring a spoiled job is not always practicable nor even advisable, even in cases where there is no hazard involved other than the reputation of the shop.



Method of shrinking a steel bushing, expanding a brass tube, and re-turning small brass rods

At the same time, a great deal of incorrect work could be rectified so that it would function in every way as well as it would properly in the first place. Every effort to eliminate waste in this direction is worthy of consideration. If the error is the result of wrong specifications or

(Continued on page 118)

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Better Shop Methods

Reclaiming Spoiled Work

(Continued from page 117)

incorrect dimensions on a drawing furnished by a customer, it may be permissible to suggest a means of saving the job in the customer's interest.

In many cases the reclaiming of a piece of work calls for considerable study and ingenuity and in any event the cost must not be greater than that of producing a new piece, unless time is the most important consideration. The following examples demonstrate what can be done to save work that at first glance seemed to be irredeemable.

Six hushings like the one shown were hored and reamed on a turret lathe. The axis of the turret was not in line with the lathe so that the reamer, which was not in a floating holder, made the hole .010 in. over size. The general opinion was that nothing could be done to save the hushings.

One of the machinists said that he would like to tackle the job, as it was something he had been up against before, so the foreman let him have a try at it. The hushings were placed in a gas furnace and heated to about 1500 deg. A hot hushing then was put quickly in a clamp between two wooden blocks and two sheets of asbestos, as shown. The whole combination was quenched in water. The first hushing quenched shrunk about .015 in. in the hole. In the others a decrease of from .012 to .015 in. was obtained. This was sufficient to allow the holes to be finished with a hand reamer, after which the hushings were turned and faced. The secret of this simple trick is to prevent the water from coming in contact with the hole.

IN ANOTHER instance I once employed a simple means to save a lot of pieces made from brass tubing. The error in this case consisted of cutting the thread under size, the result of the mechanic's having been given a wrong gage to work by. As the inside diameter was not important, it was apparent that if the tube could be expanded about 1/32 in., the thread might be recut. I turned a machine-steel plug of the shape shown. After being pack-hardened, this was driven into the tubing a distance equal to the length of thread. No difficulty was experienced in expanding the outside diameter so that the threads could be finished with a hand die to the proper size. Every piece was passed by the inspector. This simple kink got the foreman of a large screw-machine department out of possibly serious trouble. Incidentally, this is an example of work that was saved with small chance of embarrassment to any one, as there was no sacrifice in the quality of the finished pieces.

Another job I had to reclaim was a lot of brass rods turned on the small end 1/16 in. too short. It should have been 5/16 in. instead of 5/16 in. as shown on the preceding page. The error was not discovered until the rods were assembled into tools and ready to ship.

(Continued on page 119)

Better Shop Methods

Small Brushes for Shop Use Made Quickly and Cheaply

FOR years we have used emergency brushes made as shown. There are hundreds of times when a mechanic needs a brush for a little job, as for putting a finish on a neglected spot, gluing, shellacking a gasket, and the like. It takes time to hunt up a bristle brush and then perhaps the brush is too large or needs cleaning.

Just take a strip of old awning cloth, ravel it out until the threads are long enough to make a suitable brush, and wrap the cloth three or four times around a strip of veneer from a berry box or a small twig or stick. After use the brush is thrown away.

These simple little brushes have saved me many a dollar, so that I make up a hatch at a time and keep them on hand for our automobile mechanics.—JOHN R. DONOH, Normal, Ill.



Three styles of brushes

Undercutting Commutator Mica

MICA between the segments of a motor commutator can be cut down to a uniform depth with the tool illustrated. This is simply a saw blade fixed in a hardwood block, which is made with two guiding edges on one face so as to fit the commutator snugly. A transverse bolt

through the block clamps the saw in its slot. The saw is adjusted to protrude just far enough to cut grooves of the desired depth and the block guides it so as to follow each groove exactly.—G. A. LUERS.



Wooden guide for saw

Reclaiming Spoiled Work

(Continued from page 118)

I made a form-turning tool as shown, which was used in a speed lathe. The tool was placed in the chuck of the lathe and the rods were inserted into it by hand, and turned back the required 1/16 in. As the over-all length was not important, a decrease of 1/16 in. in the length in no way affected the quality of the tool.

To make the forming tool I first turned up a flat drill or cannon drill as illustrated. The dimensions of this drill corresponded to the finished dimensions of the piece. This was given the proper clearance for cutting and then hardened and tempered. It was used in the ordinary way to form the corresponding shape in the forming tool.



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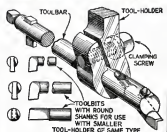
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Better Shop Methods

Tool-Holders and Toolbits for Planing, Shaping, and Slotting

FORGED tools for slotting and for cutting keyways in holes often may be replaced profitably by the type of tools illustrated. These tools are more efficient than the forged tool and at the same time considerably cheaper, since only the actual cutter is made of high-priced alloy steel. Cutters are readily made up in stock and may be ground systematically and accurately by the tool grinder.

Cutters of various forms for unusual places may be provided, such as on the



Tool-holder, toolbar and toolbits. The white arrow points to a roughing tool ready for use

planer job illustrated, where a broad-nose tool 1 in. wide is used for finishing the left side of the rectangular slot in the casting. A roughing-out tool is shown gripped in the holder, and the broad-nose finisher is lying on top of the casting to the left of the finished vertical wall of the slot.

The round shank permits the tool-setting to be corrected and allows the use of the cutter in any angular position desired. Another feature is that the shanks or special round toolbars may be made extra long to suit varying lengths and conditions of work.—O. S. MARSHALL.

Emergency Repair for Pipe Line

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 nipples, two elbows,
 and a short length
 of pipe. The pipe
 is a loose fit, so that
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 forces it against the fiber or other packing
 material used over the hole. These parts
 later can be returned to stock.—F. N. C.

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Alice Hiegle, a 13-year old Chicago girl, made \$75.00 a week in vaudeville last summer. Her musical act is constantly in demand for clubs, lodges, hotels, radio studios and private entertainments. For a 15 minute act she receives \$15.00—a dollar a minute! Read what she says: "Playing a musical instrument is lots of fun. I wish everybody knew how easy it is and how quickly you can learn, especially with Wurlitzer Instruments—they are so easy to play."—Alice Hiegle.

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Here Are the Rules in Our Great \$10,000 Contest

This Month's "What's Wrong" Pictures Appear on Pages 32 and 33

1. Every month for four months, beginning in the June issue, POPULAR SCIENCE MONTHLY is printing a set of pictures of John and Mary Newberry. Each of these pictures shows John or Mary doing some simple "job about the home" in an incorrect way. And, in addition, there is a deliberate error in the drawing of each picture. You are to tell us what two things are wrong in each picture and why they are wrong.
2. There are four complete monthly contests, each of eight pictures. The first was in the June issue, a second was in the July issue, the third in the August issue, and the last appears in this issue on pages 31, 32, and 33. In addition, there will be a Grand Prize Contest covering all of the 32 pictures printed in the four months of the contest.
3. POPULAR SCIENCE MONTHLY is awarding \$10,000 in 320 cash prizes for the best answers submitted in the contest.

The cash prizes in each of the four monthly contests are as follows:

First Prize	\$500
Second Prize	\$100
Third Prize	\$50
Next 5 Prizes, \$10 each	\$500
Next 60 Prizes, \$5 each	\$300
Monthly total	\$1000
Four months' total	\$4000

4. In addition, cash prizes in the Grand Contest will be paid as follows:

First Prize	\$2500
Second Prize	\$1000
Third Prize	\$500
Next 5 Prizes, \$50 each	\$250
Next 50 Prizes, \$10 each	\$500
Next 250 Prizes, \$5 each	\$1250
Total Grand Prizes	\$6000
Total Prizes	\$10,000

HOW TO COMPETE

5. In connection with each picture these questions must be answered: "What job is being performed improperly in this picture and how should it be done correctly?" And (2) "What error has the artist made in drawing the picture and why is it wrong?" A list of errors—two for each picture—is in the custody of the judges and will be used as a basis for the selection of the prize-winners. Prizes in all of the contests will be awarded to those persons who answer best the questions for the largest number of the pictures. It is provided, however, that as between contestants having the same number of correct solutions the selection of winners will be based upon (1) accuracy, (2) clearness and (3) skill of presentation. In case of ties,

a duplicate award will be given to each tying contestant.

6. Answers to each set of eight pictures must be received not later than the thirtieth of the month following the date of publication of the magazine in which the pictures appear. Thus, to insure consideration in this month's contest, answers to the eight pictures in this issue, published August 10, must reach the office of POPULAR SCIENCE MONTHLY not later than September 30. Pictures received by this date will be entered automatically in the Grand Prize Contest also. Contestants, however, may enter for the Grand Prize Contest any time before September 30, without having entered a monthly contest. Contestants also may hold the answers to all pictures until they have a complete set of 32 before submitting the answers. It better stipulate, however, that no such entry will be received after September 30.

WHEN SUBMITTING ANSWERS

7. Contestants may submit as many answers as they wish to pictures in either the monthly contests or in the Grand Prize Contest, but each must be submitted in good faith. Answers may be submitted on any kind of paper, but the writing must be legible and on one side of the paper only. Each picture will be numbered plainly and contestants must attach to their answers either the corresponding picture cut from the magazine or the number of the picture. The winning of one or more monthly prizes will not bar the winner from winning a Grand Prize, if he should submit answers.

8. All entries should be addressed to the Picture Contest Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each entry. An entry with insufficient postage will be rejected. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be returned.

9. Prize-winners in this month's contest will be announced in the February issue of POPULAR SCIENCE MONTHLY, published January 10. The names of the winners of Grand Prizes will be announced and the correct solutions published as soon as possible after the close of the final month's contest.

10. You pay nothing. Just prove your knowledge and observation. You need not purchase POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or take one at any of the offices of POPULAR SCIENCE MONTHLY or at public libraries free of charge. These contests are open to every one, except employees of POPULAR SCIENCE MONTHLY and the Popular Science Institute of Standards and their families. The officials of the Popular Science Institute of Standards will act as judges and their decision will be final. Acceptance of these rules is an express condition of each entry.

See pages 32 and 33 of this issue for the final set of pictures in this remarkable contest.

IF YOU have mislaid the June, July, and August issues of POPULAR SCIENCE MONTHLY containing the first three sets of Contest pictures, and if your newsdealer cannot supply you, copies of these issues are available for your free use at the public libraries or at the offices of this magazine. Or, if you prefer, you can obtain copies at 25 cents each from the Picture Contest Editor, Popular Science Monthly, 250 Fourth Ave., New York City

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Cracks in the Earth Menace American Cities

(Continued from page 122)

ually are becoming larger, while the continents are being compressed so that the land areas are rising as the sea front retreats. The contours of the United States show this.

It is believed that the shores of the American continent once were connected with Africa, or at least were separated only by a narrow strait. Since the Atlantic has been enlarged, the plateaus in the western states and the mountain ranges all have been raised considerably. These movements always have been connected with volcanic activities. The land areas have been faulted by condensation waves caused by the falling in of large areas of the sea floor; by gravitational waves caused by landslides, near faults in the rock masses, and by stationary waves set up by local deformations caused by landslides and similar movements. All of these have been in operation along the Pacific coast earthquake zone.

Arizona, Kansas, Oklahoma, and Arkansas are the seats of frequent earthquake shocks. Quakes, of more or less severity, are felt in those states annually. The whole valley of the Mississippi is undoubtedly situated on a line of faults, constituting an earthquake zone. Alabama and Tennessee have earthquake records showing that the earth's crust in those states is not strong. The Virginias are on a similar line of weakness and this line can be traced along the Atlantic coast to Canada and Newfoundland. There is a pronounced fault in the seabed off the coast of Maine which appears to be connected with faults running past New York.

The St. Lawrence, the Great Lakes, and a series of lakes and waterways running through Manitoba, Alberta, and Saskatchewan and through the Mackenzie Valley to the Arctic—these form a great line of faulting along which most of the earthquakes experienced in North America are felt.

A Clinic by Long Distance

WHILE they looked at a photograph thrown on a screen, representing the heartbeat of a patient, 1500 doctors at Atlantic City recently listened to a Chicago physician's diagnosis coming over 1000 miles of telephone wires. The first long distance medical clinic was a dramatic demonstration of how distance soon will be practically meaningless in the diagnosis of disease.

The patient's heart was examined with a stethoscope. By means of a new apparatus developed by Dr. H. B. Williams of Columbia University and the Bell Telephone laboratories, a chart of his heartbeat, called a "stethogram," was made. This was sent to Chicago in seven minutes by the new method of sending pictures by wire.

Doctor James Greer of Chicago made a diagnosis, and when the stethogram was thrown on the screen in Atlantic City, gave the diagnosis over the telephone. It was amplified so that all could hear it.

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"It's a High Pressure Job"

(Continued from page 17)

not half the risk those chaps up there are takin' every day. If it was a risky job, how do you suppose they put them two big vehicle tunnels under the Hudson River without losin' a man? Twelve hundred sandhogs worked on that job, an' I was one o' them. Never less than 300 of us at work at once, an' the only two men killed on the job was not sandhogs. One fell down a shaft an' the other got caught in the works of a pump. How many big buildin' kill as few iron-workers as that?

"SURE, there's risks, but nothing like what they used to be. When they started the very first try at tunnel under the Hudson, more'n 50 years ago, the tunnel caved an' 20 men was drowned. That was before they knew how to work the air like they do now.

"Y' see, down in the caisson or out at the tunnel headin', the trick is to keep the cuttin' edges covered with the stuff you're workin' in—mud or clay or whatever it is. If your caisson is level an' your air pressure is right, you don't have no trouble. You've got to have air enough to equalize the water pressure and not enough to blow out the mud. You're diggin' from the middle toward the edges all the time, and shovin' the caisson down or the tunnel headin' across as fast as you can get to the edges. Now, if your mud blows out, you've got a blowout, and the air alone can't hold the water back, unless you can get more pressure in a big hurry, an' you can't always do that.

"There's always plenty of bags of hay and bags of clay handy, to plug up any hole where the air is escapin'. You can tell by the sound when the leak begins. An' sometimes, when there ain't enough of that sort of stuff to plug the hole, there's other ways. I mind me once—it was in the Pennsylvania tunnel—when Red Kelly, that was workin' alongside o' me, sat in a blowhole to stop it while we got up the hay bags! It's a good thing most sandhogs ain't skinny.

"THERE ain't much danger if the boss keeps his head. There was a blowout one night in the Manhattan Bridge caisson. There was eight of us inside, workin' in about 35 pounds of air, pretty near 80 feet down; Jimmy Durkin, Jimmy Appleby, an' myself, an' five Swedes. The air chamber was about 10 feet above our heads, an' there was a ladder to the shaft openin'. The shaft would only take in one man at a time. One side of the caisson rested on loose silt, an' needed watchin' all the time.

"Well, we was near the end o' the shift when one o' the Swedes hollered, 'Look at dat!' We looked, an' the silt was crumblin'. Next we knew, it blew out like an explosion an' the water rushed in. Four o' them Swedes made a rush for the ladder, an' we might all have been drowned if the other Swede hadn't picked up a pick handle and whacked 'em over the head. Then we got out, one at a time, with water up to our waists before the last one went up the ladder.

(Continued on page 126)

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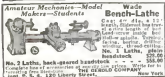
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No. 99 Lathe, back-sawed hardwood, 606" x 618" x 618", \$1995.00
No. 100 Lathe, back-sawed hardwood, 612" x 624" x 624", \$2015.00
No. 101 Lathe, back-sawed hardwood, 618" x 630" x 630", \$2035.00
No. 102 Lathe, back-sawed hardwood, 624" x 636" x 636", \$2055.00
No. 103 Lathe, back-sawed hardwood, 630" x 642" x 642", \$2075.00
No. 104 Lathe, back-sawed hardwood, 636" x 648" x 648", \$2095.00
No. 105 Lathe, back-sawed hardwood, 642" x 654" x 654", \$2115.00
No. 106 Lathe, back-sawed hardwood, 648" x 660" x 660", \$2135.00
No. 107 Lathe, back-sawed hardwood, 654" x 666" x 666", \$2155.00
No. 108 Lathe, back-sawed hardwood, 660" x 672" x 672", \$2175.00
No. 109 Lathe, back-sawed hardwood, 666" x 678" x 678", \$2195.00
No. 110 Lathe, back-sawed hardwood, 672" x 684" x 684", \$2215.00
No. 111 Lathe, back-sawed hardwood, 678" x 690" x 690", \$2235.00
No. 112 Lathe, back-sawed hardwood, 684" x 696" x 696", \$2255.00
No. 113 Lathe, back-sawed hardwood, 690" x 702" x 702", \$2275.00
No. 114 Lathe, back-sawed hardwood, 696" x 708" x 708", \$2295.00
No. 115 Lathe, back-sawed hardwood, 702" x 714" x 714", \$2315.00
No. 116 Lathe, back-sawed hardwood, 708" x 720" x 720", \$2335.00
No. 117 Lathe, back-sawed hardwood, 714" x 726" x 726", \$2355.00
No. 118 Lathe, back-sawed hardwood, 720" x 732" x 732", \$2375.00
No. 119 Lathe, back-sawed hardwood, 726" x 738" x 738", \$2395.00
No. 120 Lathe, back-sawed hardwood, 732" x 744" x 744", \$2415.00
No. 121 Lathe, back-sawed hardwood, 738" x 750" x 750", \$2435.00
No. 122 Lathe, back-sawed hardwood, 744" x 756" x 756", \$2455.00
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No. 124 Lathe, back-sawed hardwood, 756" x 768" x 768", \$2495.00
No. 125 Lathe, back-sawed hardwood, 762" x 774" x 774", \$2515.00
No. 126 Lathe, back-sawed hardwood, 768" x 780" x 780", \$2535.00
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No. 128 Lathe, back-sawed hardwood, 780" x 792" x 792", \$2575.00
No. 129 Lathe, back-sawed hardwood, 786" x 798" x 798", \$2595.00
No. 130 Lathe, back-sawed hardwood, 792" x 804" x 804", \$2615.00
No. 131 Lathe, back-sawed hardwood, 798" x 810" x 810", \$2635.00
No. 132 Lathe, back-sawed hardwood, 804" x 816" x 816", \$2655.00
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No. 140 Lathe, back-sawed hardwood, 852" x 864" x 864", \$2815.00
No. 141 Lathe, back-sawed hardwood, 858" x 870" x 870", \$2835.00
No. 142 Lathe, back-sawed hardwood, 864" x 876" x 876", \$2855.00
No. 143 Lathe, back-sawed hardwood, 870" x 882" x 882", \$2875.00
No. 144 Lathe, back-sawed hardwood, 876" x 888" x 888", \$2895.00
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No. 154 Lathe, back-sawed hardwood, 936" x 948" x 948", \$3095.00
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No. 196 Lathe, back-sawed hardwood, 1188" x 1200" x 1200", \$3935.00
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No. 224 Lathe, back-sawed hardwood, 1356" x 1368" x 1368", \$4495.00
No. 225 Lathe, back-sawed hardwood, 1362" x 1374" x 1374", \$4515.00
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No. 227 Lathe, back-sawed hardwood, 1374" x 1386" x 1386", \$4555.00
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Birth of the Airplane

(Continued from page 129)

within sight and sound of the thundering Atlantic, the inventors had many little adventures. These they recorded in home letters with comical appreciation, almost to the dawning of their high objective. There was a midnight battle with a tarpaper roof in a gale. Orville invented a French-drip coffee-pot to save the use of eggs. A carbide can was converted into a wood stove. As medical advice to Charley Taylor, who wrote from Dayton that he suffered from unsteady legs, Orville suggested bracing his legs with the truss system employed in his biplane.

AT THIS time Wilbur was 36 and Orville 32. Both were of slender, athletic build. The elder stood 5 feet 10½ inches, or a trifle less than two inches above his brother. They were both smooth shaven and both had grayish blue eyes.

The propeller shafts twisted under strain of the first engine test at Kitty Hawk. In the next test the propeller sprockets came loose.

Things looked dark when a third accident—a bit of metal broken out of a new shaft—occurred in late November. Now the power machine was again helpless, before ever it had been tried in the air.

Four miles through deep sand, lugging two suitcases filled mostly with metal gear, hiked Orville to Kitty Hawk. He took a boat to Elizabeth City and then a northbound train. When he arrived in Dayton he hadn't five cents left for carfare. Weighted down with those suitcases, he walked 1½ miles to his home.

It took a week to obtain new shafts of spring steel, and Orville hustled back to Kitty Hawk with them. Thank heaven, the boodoo was over. The power plant stood the Saturday test with engine aroar, screws speeding.

Wilbur was first of mankind to fly in a power machine, on Monday, December 14, three days before the official, accepted date for that event. To be sure, his time was but 3½ seconds and his distance 105 feet, and the hop ended in a partial wreck.

ORVILLE went up first on the commemorated December 17, 1903, remaining about 12 seconds in the air, but not much exceeding his brother's previous distance. Wilbur now followed in a similar flight. Orville had another turn of short duration. Then, just at noon, Wilbur stepped forward for the fourth and last flight.

It was a cold, dull day. Whitecaps were visible on the near-by Atlantic and ice was forming in Albemarle Sound. The aviators were chilly, having no special garments for their work. Doubtless the five spectators—three men of the government life-saving station, a lumber buyer, and a 16-year-old boy—were also cold and wished to have the affair over. Even the muse of history, we may imagine, got impatient and had to blow on her stylus-bolding fingers to keep them warm.

Wilbur hastened to oblige. He covered a ground distance of 852 feet in 59 seconds, whereupon Clio said, "So that's that," and the meeting adjourned sine die.

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He Has Staged More Battles than Napoleon

(Continued from page 45)

bet that she doesn't mention how it happened. The stars earn their big salaries.

"Bravest of all of them are Gloria Swanson and Henry B. Walthall.

"In one picture it was my job—and incidentally it was the toughest job of my whole career—to blow an entire dirt trench over Walthall. That he was to be buried under 10 or 12 feet of earth didn't seem to worry him. 'Slim,' he said, 'can you do it?'

"Easy," I replied, the cold shivers running up my spine.

"Then shoot," said Walthall.

"The shot went off, and it took exactly six minutes for 10 men to dig Walthall out from under that pile of dirt. When they dragged him into the air once more, he was a little white around the gills and a little out of breath, but his 'Great work, Slim,' meant far more to me than the magnificent thrill the test pictures showed next day.

"AND Gloria Swanson—God bless her—is the gamest little woman I ever have known. No doubles for her in explosive scenes, nor temperament. She is just a great little trouper who wholeheartedly would eat a dozen sticks of dynamite if it were necessary for a scene."

A wood fire will not photograph, hence, it was one of Hoffman's jobs to concoct a chemical that would give every appearance of roaring flames. The remarkable part of it is that he found one that would burn without damage. Give him your finest piece of tapestry or antique furniture and he will set it all ablaze with this chemical, then return it to you unscratched. Or he can set a roomful of elaborate furnishings afire, let it burn a while, then extinguish the fire, and you cannot trace a single effect of the flames—even on the most delicate of wallpaper.

The mysterious chemical will flame just so long without burning. A second longer and the whole works is ruined. Consequently, this sort of shooting demands split-second timing on the part of both Hoffman and the cameraman.

Dynamite has the same sort of temperament as a tiger. It is docile for just so long, then, like the big cat, it is likely to do the unexpected. So it is not safe to lose respect for dynamite. It isn't a toy and men who handle dynamite daily as a business are very careful of their safety.

Has Hoffman ever been burned?

Yes. It happened the way all accidents occur.

LADY LUCK, like all women, is fickle. The moment a man deserts his chosen profession, Miss Fortune begins vamping him. Witness the lion-tamer who was poisoned by a pet kitten's scratch, and the steeple-jack who fell downstairs and broke his leg. Add to them Hoffman, who was asked to hold a lighting torch (a flare that lights scenes in silent movies when electricity is not available). It exploded in his face and peeled off most of his skin. That Hoffman is with us today is due to a wealth of vitality and a pal who parted with great patches of skin,



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How to Build a Wave Trap

(Continued from page 79)

causing most of the trouble.

If, on the other hand, several stations are interfering with the one you want to receive, the parallel connection may prove more useful; for when the wave trap is hooked up in this fashion, it is tuned to the station you want to receive and signals from all stations on other waves are cut down in strength.

It is desirable to mount the wave trap a foot or more from the receiver so that the magnetic coupling between the coils in the wave trap and the receiver will be at a minimum.

Tuning the wave trap is very simple. When it is connected in series, the receiver itself is tuned first to the wave of the interfering station, and then the dial on the wave trap is turned slowly until the signal disappears or is as weak as possible. Then the receiver is retuned to the wave of the desired station. Tuning the wave trap in the parallel connection is exactly the reverse. The desired station is first tuned in on the receiver and then the wave-trap dial is adjusted until the interfering signals are cut down as much as possible.

NOW for the adjustment of coil A. If you have too many turns in this coil when the wave trap is used in the series connection, the wave trap will be too effective; that is, it will cut down the signal strength of the station you want to receive, besides eliminating the undesired one.

In the parallel connection, on the other hand, too few turns make the wave trap very effective at the expense of the signal strength of the station you desire to receive, while a large number of turns in coil A reduces the effectiveness of the wave trap.

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Ancient Hunters and Their Modern Representatives, by W. J. Sollas, Sc.D., professor of Geology and Paleontology at Oxford University. Third edition of a popular work on archeology. Illustrated. The Macmillan Company.

The Story of Copper, by Watson Davis, C.E. An interesting, non-technical history of the first of the useful metals. The Century Co.

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Here Are Correct Answers to Questions on Page 69

1. They are forced up by atmospheric pressure. When you suck on the straw, that makes a partial vacuum in your mouth and in the upper part of the straw. Instantly the pressure of the air outside forces some of the liquid into your mouth, just as it does with any kind of a suction pump.

2. To prevent the breaking of their ear drums. The part of the ear back of the drum communicates by means of a tube with the throat. If the mouth is open, the air wave from the fired gun goes in through the throat as well as into the ear. Its push against the outside of the drum will be neutralized by an equal push against the inside.

3. Several kinds are known. The commonest is made by dissolving a little cobalt chloride in water. This makes a light pink solution. Writing made with it is invisible so long as it is damp. When you heat it and dry it out, it turns blue and can be read. Let it stand a while and it will take up moisture again from the air, turn light pink and disappear. This may be repeated many times.

4. Nearly 1,600,000 miles; about $18\frac{1}{2}$ miles a second.

5. The waves wear down the rocks and break them up. The fine dust that is produced is carried out to sea by the water and is deposited on the bottom, but the coarser particles stay on the beach and make the sand.

6. Places in which the sun is cooler and does not give out quite so much heat and light. They are believed to be caused by great whirling storms in the surface layers of the sun. Some of them are large enough for five or six spheres like the earth to be dropped inside the whirling center of the storm.

7. Hydrogen peroxide sets free an especially active kind of oxygen. This active oxygen combines chemically with the colored substances in the hair and turns them into other compounds that are colorless or light yellow.

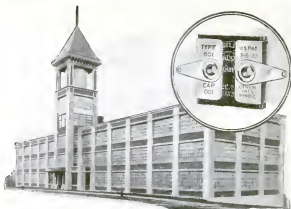
8. If there were any air inside the bulb the hot tungsten in the filament would combine with the oxygen of the air and burn up, just as a cotton thread would burn up in a hot furnace.

9. By means of a blanket of fat that almost entirely surrounds the body. It is this fat or blubber that provides much of the oil we get from whales.

10. Because it is only when it is hot that it emits the continual stream of electrons needed to operate the vacuum tube. This ability of hot metallic wires to emit electrons in a vacuum is what scientists call "thermionic emission."

11. A kind of eucalyptus, or blue-gum, which grows in Australia. Individual trees of this species have been known to grow 400 feet tall.

12. This is another effect of the chemical discharged by your adrenal glands. This chemical makes all the tiny blood vessels in the skin and in the surface layers of the body contract so that most of the blood is squeezed out of them. Of course, this has the effect of making your face seem whiter.



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